

9. Involucral leaves short (5–7 mm.), not covering mature seed; foliage leaves robust. 25. *D. kinabaluensis*.
8. Leaves bifacially flattened.
10. Involucral leaves long (5–6 mm.); foliage leaves long and narrow (2–5 mm. by 0.4–0.6 mm.). 26. *D. cinctus*.
10. Involucral leaves less than 5 mm. long; foliage leaves short and wide (2–4 mm. by 0.6–1.0 mm.).
11. Pollen cone lateral; seed not large (5–6 mm. long); foliage leaves spreading. 27. *D. expansus*.
11. Pollen cone terminal; seed large (7–8 mm. long); foliage leaves imbricate. 28. *D. compactus*.

21. *Dacrycarpus imbricatus* (Blume) de Laubenfels, comb. nov.

Podocarpus imbricata Blume, Enum. Pl. Javae 1: 89. 1827. Lectotype: *Blume s.n.*, W. Java.

Podocarpus cupressina R. Br. ex Mirb. Mém. Mus. Hist. Nat. Paris 13: 75. 1825 (*nomen*); R. Br. ex Horsfield, Pl. Jav. Rar. 1: 35. *t.* 10. 1838. Type: *Horsfield s.n.*, Java.

Podocarpus horsfieldii Wallich, Cat. No. 6049. 1832. *Nomen nudum*.

Nageia cupressina (R. Br.) Muell. Phyt. New Hebr. 20. 1874.

Tree up to at least 30 m. tall; bark dark brown or blackish on the surface, weathering gray, inside a rich red-brown and granular (slightly fibrous), breaking off in small thick scales with a rough surface; juvenile leaves bilaterally flattened and distichous, nearly linear, curving outward from the base and upward at the tip, narrowing rapidly to a fine mucro, 10–17 mm. long and 1.2–2.2 mm. wide, shorter toward the branch tip and base, the first leaves at the branch base short and acicular, the whole foliage branch of limited growth; leaves on seedlings and on penultimate branches quite distinct, bifacially flattened, lanceolate, mucronate, imbricate, decurrent, 2–4 mm. long and 0.7–1.0 mm. wide; terminal shoots on young plants sometimes very long, whip-like, up to 20 cm.; on older plants more compact, the foliage leaves becoming progressively smaller, fertile specimens sometimes having distichous and bilaterally flattened leaves 3–5 mm. long and 0.6–0.8 mm. wide; foliage leaves in older trees eventually becoming short and needle-like or more or less scale-like, about 1–1.8 mm. long, strongly keeled and acute but neither flattened nor distichous; pollen cones lateral or rarely terminal, subtended by a few scale leaves on a branchlet 1–3 mm. long, oval but elongating with the shedding of pollen, to 6–12 mm. long and 2–2.5 mm. in diam. (about 5 mm. long before elongating); microsporophyll triangular, acute to apiculate; seed cone terminal, often on a short lateral branch bearing scales which become elongated just below the receptacle, forming an involucre, the involucral leaves spreading and generally less than 4 mm. long, acicular and sharply pointed; seed cone a short, warty, glaucous receptacle 3–4 mm. long, formed of enlarged bract bases, the tips of one or two bracts (resembling the involucral leaves) projecting from the receptacle, one or two terminal bracts fertile, the whole receptacle be-

coming red upon maturity; mature seed globose, slightly ribbed on the back with a blunt crest, 4–6 mm. in diam., 5–6 mm. long.

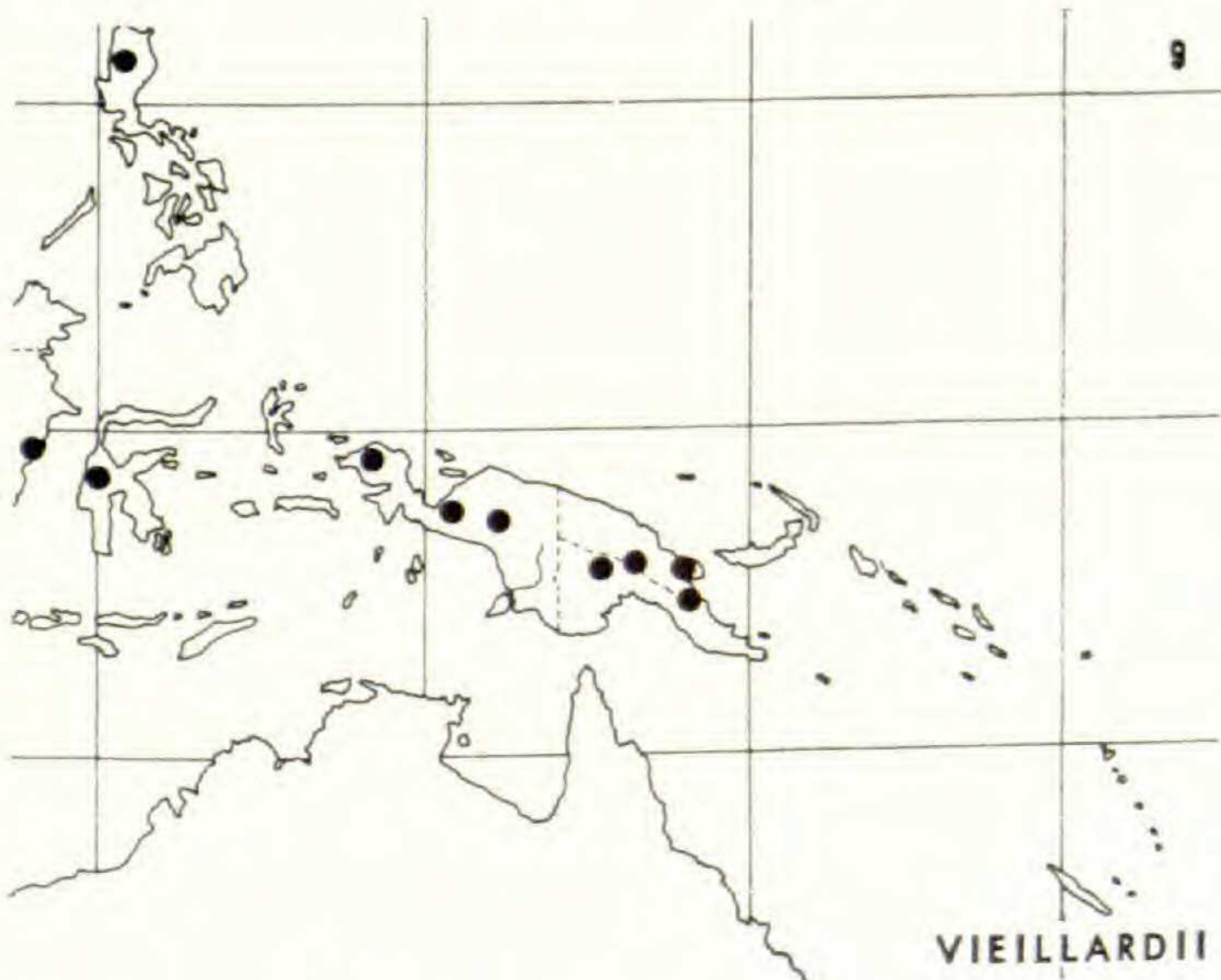
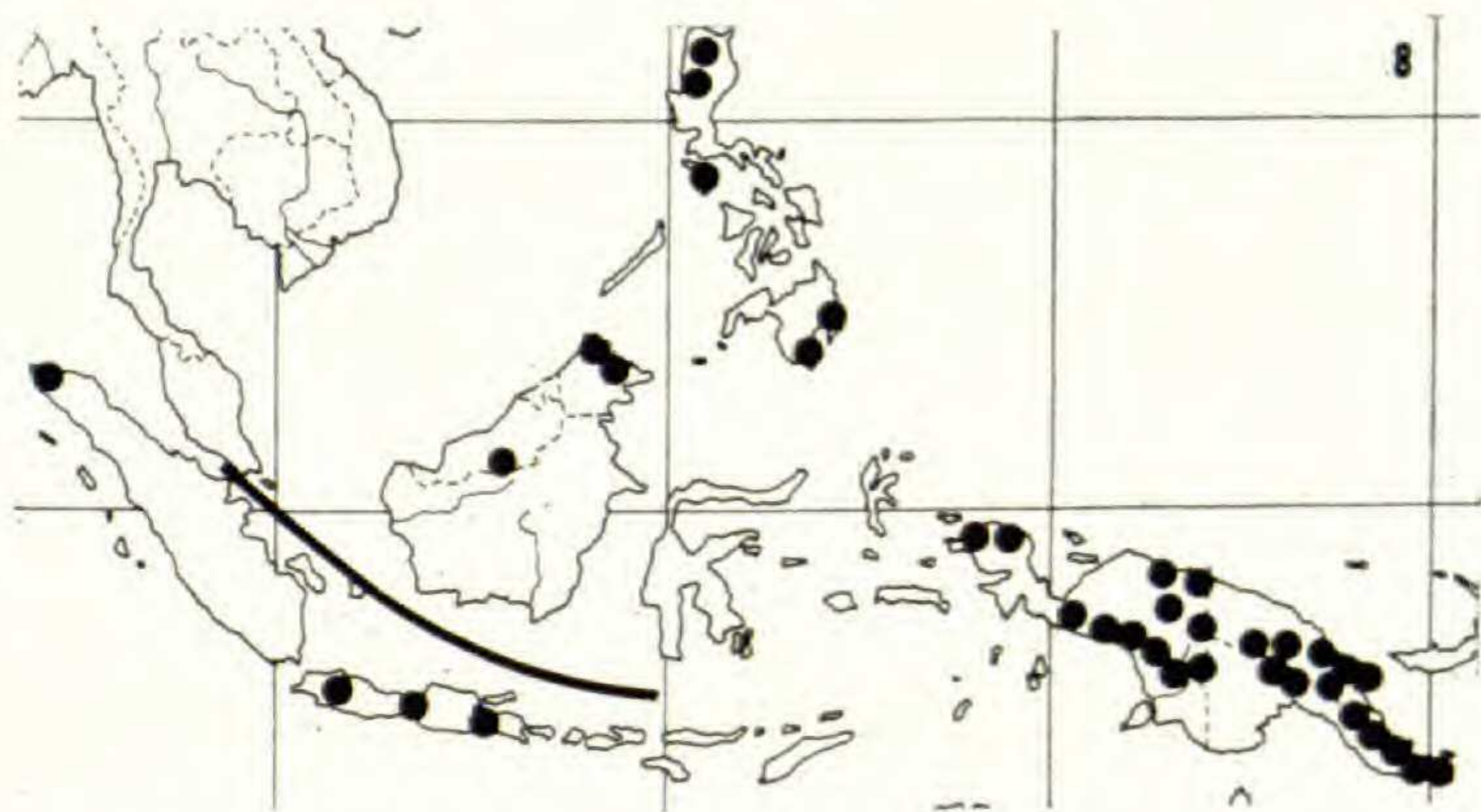
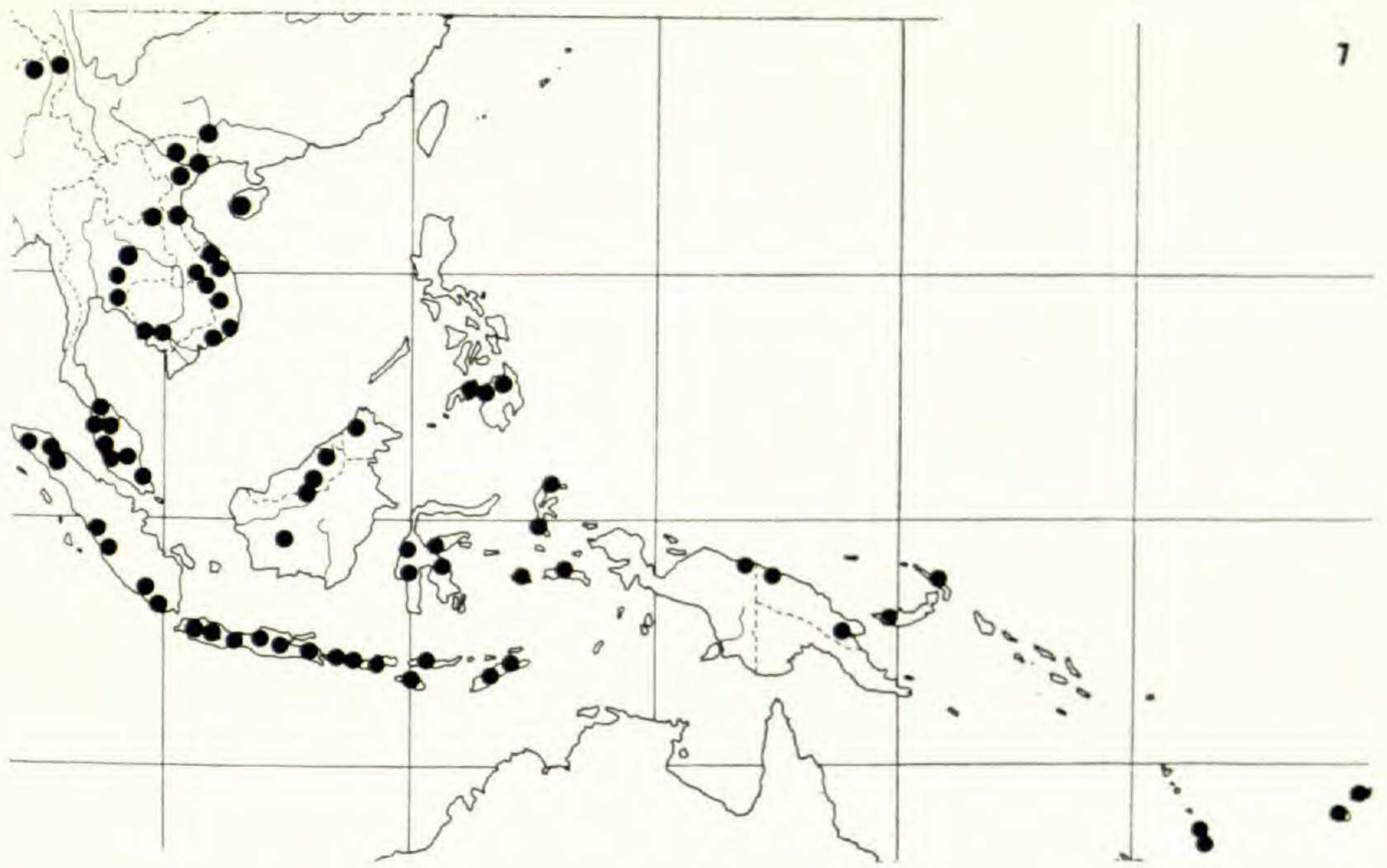
The short acicular or scale leaves and the lateral more or less oval pollen cone distinguish this widespread species from other members of the genus. Longer leaves occur on fertile specimens but, if present, are less than 5 mm. long and very robust (var. *robustus*) or are distichous. *Dacrycarpus imbricatus* can be subdivided into four varieties on the basis of mature foliage leaf form (FIG. 8). The reproductive structures and immature leaves of the varieties are indistinguishable. When identifying these varieties, care must be taken to compare the leaves of only the ultimate foliage branchlets and not the distinct penultimate scale-covered branches (the penultimate branches of all varieties resemble the foliage branches of var. *imbricatus*).

21a. Var. *imbricatus*.

Mature foliage leaves strongly appressed, slender, about 1.5 mm. long and 0.6 mm. wide, the whole foliage branch 0.75–1.25 mm. in diam.; involucre leaves 2–4 mm. long. FIG. 8a.

DISTRIBUTION. Scattered and common in rainforests from low elevation up to about 3,000 meters, but particularly from 700 to 2,400 meters (agriculture has commonly destroyed the forests at low elevation); in Java and the Lesser Sunda Islands, and occasionally in Celebes and Borneo. MAP 7.

Java. G. Salak, *Koorders* 24182 j (L), *Lobb s.n.* s (K). Tjibodas (Preanger), 1,400–1,500 m. *Koorders* 1270 s (L), 1273 s (L), 15534 j (L), 25922 ♀ (L), *Koorders & Huven s.n.* s (L), *Burlage s.n.* j 600 m. (L), *Raap* 713 ♀ 1,400 m. (L), 768 ♀ (L). G. Gedeh, *De Vriese s.n.* ♀ (L), *Van Steenis* 17544 ♀ (L), *Verheul* (1957) ♂ (L), *Kuntze* 4702 s 2,000 m. (NY). Dorowati, *Kuntze* 5865 s (NY). G. Pangrango, *Schiffner* 1475 ♂ 1,900 m. (L), *Palmer & Bryant* 988 j 2,900 m. (US), *Winkler* 1866 j 2,400 m. (K). Gegerbintang (Preanger), *Den Berger* 549 ♀ 1,100 m. (L). Mt. Tankuban Prau, *Anderson* 67 s (K). Upper Lembang, *Junghuhn s.n.* ♀ (L). Bandang, *Junghuhn s.n.* s (L). Takokok (Preanger), 1,150 m. *Koorders* 15535 ♀ (A, L), 27704 s (L). G. Besser, *Winckel s.n.* j 1,100 m. (L). Pangentjongan (Preanger), *Koorders* 1275 j (L), 14141 ♀ (L). Preanger, *Warburg* 11119 j (NY), *Koorders* 12608 ♀ (A), 39364 ♂ (A) 39366 ♀ (A). Tjibeber, *Backhuizen* 1811 s, j 1,000 m. (L), 1936 j 1,300 m. (L). G. Slamet (Pehalongen), *Brascamp* 18 j 1,800 m. (L). G. Malabar, *Reinwardt s.n.* (L). G. Ungaran (Semarang), 1,000–1,350 m. *Koorders* 1283 s (L), 1284 j (L), 1285 j (L), 27705 ♀ (K, L). G. Kukusan (Lawu), *Elbert* 52 j 1,500–1,700 m. (L). Ngebel (Madiun), 1,450 m. *Koorders* 1278 s (L), 1279 j (L), 1280 ♀ (L), 1281 s, j (L), 1282 j (L), 29188 j (L), 29189 ♀ (A), 38626 j (L), 38652 j (L). G. Ardjuno (Pasuruan), *Koorders* 38187 ♀ 2,100–2,400 m. (L). Ngadasari, *Koorders* 37922 s (L), 37923 j (K, L). Ngadiwono, *La Rinere s.n.* s 1,600 m. (L). Idjen Plateau (Besuki), 1,700 m. *Koorders* 1290 j (L), 1296 ♀ (L), 1297 j (L). G. Kendeng, *Koorders* 28507 ♀ (A). G. Tapandajan, *Coert* 637 j 1,750 m. (L). G. Tenga (Parverua), *Dugeh* 1382 j 1,600 m. (L). Parverua, *Oillering* 175 s (L). G. Guntar, *Anderson* 429 j 4–6,000 ft. (K). E. Java, *Coert* 1437 s



MAPS showing distribution of: 7, *Dacrycarpus imbricatus* (Blume) de Laubenfels, var. *imbricatus* and var. *patulus* de Laubenfels; 8, *D. imbricatus* var. *robustus* de Laubenfels (dots north of line), and var. *curvulus* (Miquel) de Laubenfels (dots south of line); 9, *D. steupii* (Wasscher) de Laubenfels (dots), *D. vieillardii* known only from New Caledonia.

(L), *Went s.n.* j (L). Without loc. *Blume 492* ♀ (L), *s.n.* ♀ (L-lectotype of *Podocarpus imbricata*), *Junghuhn s.n.* j (L), *Horsfield s.n.* ♀ (K-holotype of *Podocarpus cupressina*; GH-isotype), 108 s (K), 1166 ♀ (K), *Korthals s.n.* j (L), *van Hasselt s.n.* s, j (L), *Simmoro s.n.* s 3–4,000 ft. (L), *Coert 1209* s (L), *Zollinger 2262* ♀, j (A, z), *De Vriese s.n.* ♀ (K), *Miquel s.n.* s (K). **Lesser Sunda Is.** BALI: Mt. Batukan, *Kostermans, Kuswata, Sugeng & Supadmo KK & SS 138* ♀ 1,300 m. (A, K, L), *Sarip 371* j 1,930 m. (L). Buleleng, *NIFS bb17269* ♂ 1,300 m. (A, L). LOMBOK: Mt. Rindjani, *Elbert 2266* j 700–1,700 m. (A, L). Lenek (mid.), *NIFS bb15504* ♀ 700 m. (K, L). Plambi (SW.), *Elbert 2428* j 200–400 m. (L). SUMBAWA: Batu-Lanteh Mts. (N.), *Elbert 4191* j 1,500–1,700 m. (A, L, US). FLORES: *Rensch 1307* j (K). G. Kasterso, *Posthumus 3235* j 1,800 m. (L). SUMBA: Lairondja (E.), *Ibut 547* j (L), *NIFS bb9003* j 1,000 m. (K, L). TIMOR: Nenas (mid.), *NIFS bb11803* ♀ 1,600 m. (L). Mt. Perdido (cent. Port.), *Van Steenis 18267* ♂ 1,600–1,750 m. (L). Without loc., *Forbes 3855* ♂ (A, L). Sarawak. Kuching, *Clemens s.n.* j (NY). Mt. Dulit, *Richards 1768* j 1,300 m. (K, L). Kapit, Upper Rejang R., *Clemens 21066* j (NY). Brunei. B. Ulak, *Ashton BRUN 1032* j 4,300 ft. (K, L). B. Pagon, *Ashton BRUN 1065* ♂ 4,750 ft. (K, L). North Borneo. Ranau, *Sadaw 42890* ♀ 4,920 ft. (K, L), *Sario SAN 32246* ♂ (K), *Lajangah SAN 33085* j (K). Tambunan, *Mikil SAN 32070* j (K). Borneo. Sakumbang, *Korthals s.n.* s, j (L). B. Raja, *Winkler 1035* j 1,700 m. (L). Celebes. G. Bantaeng, *Bünnemeyer 11903* s 2,300 m. (K, L), 12019 ♀ 2,060 m. (A, L), *NIFS bb5460* ♀ 2,000 m. (L), *Everett 42* j 7–10,000 ft. (K). Roto (Masamba), *NIFS bb24957* j (L). G. Kambuno (Masamba), *Eyma 1369* j (L). Enrekang (Rantelmo), *NIFS bb29195* j 1,600 m. (A, L). Upper Binuang, *NIFS bb20202* j (A, K, L, NY). Mt. Mambuliling, *De-Froidville 173* j (L). Betw. Angin-Angin and Pintealon (Enrekang), *Eyma 570* j 1,550–2,600 m. (A, K, L).

ILLUSTRATIONS. BENNETT, J. J., *Pl. Jav. Rar.*, t. 10. 1838, as *Podocarpus cupressina*; BLUME, K. L., *Rumphia 3: t. 172 & t. 172B.* 1849, as *Podocarpus cupressina*; PILGER, R., *Pflanzenreich IV. 5 (Heft 18): fig. 7E.* 1903; *Nat. Pflanzenfam. ed. 2. 13: t. 124E.* 1926, as *Podocarpus imbricatus*; KOORDERS, S. H., & TH. VALETON, *Atlas der Baumarten von Java 3: t. 585 & 586.* 1915, as *Podocarpus imbricata*; WASSCHER, J., *Blumea 4: t. 4, fig. 2.* 1941, as *Podocarpus imbricata*.

The variety *imbricatus* is well known in Java and the Lesser Sunda Islands and is widely cultivated. Because there have been only scattered collections elsewhere, the possibility of artificial introduction must be considered. Juvenile plants can not be identified to variety in this species so they have been assigned to whatever mature form is known in the vicinity. Some rather large juvenile leaves appear in the collections from the Lesser Sunda Islands.

21b. Var. *patulus* de Laubenfels, var. nov.

Podocarpus kawaii Hayata, *Bull. Econ. Indochine 20: 439.* 1917. Type: Hayata in 1917, Tonkin.

Folia patula, acicularia, falcata, basi carinata, acuta, 0.8–1.5 mm. longa, 0.4–0.6 mm. lata; ramuli foliis inclusis 1–2 mm. diametro; folia involu-



FIGURE 8. a, *Dacrycarpus imbricatus* (Blume) de Laubenfels var. *imbricatus*, fragments showing mature foliage form; b, var. *patulus* de Laubenfels, portion of holotype de Laubenfels P328 (A); a and b, $\times 0.9$; c, var. *robustus* de Laubenfels, fragments showing mature foliage form; d, var. *curvulus* (Miquel) de Laubenfels, fragments, showing mature foliage form, c and d, $\times 0.8$.

cralia 1–3 mm. longa. Holotypus: de Laubenfels P328 (A), Fiji Nandari-vatu. FIG. 8b.

DISTRIBUTION. Scattered and common in rainforests from low elevation up to 2,500 meters, particularly from 700 to 1,700 meters and lower where moist forests occur; from Upper Burma to Fiji, particularly from South China to Sumatra, otherwise apparently in a more or less discon-

tinuous distribution overlapping with other varieties of the species and in isolated populations east of New Guinea. MAP 7.

Burma. Hukong Valley, *Hole 21* s (κ). Serpentine Mines (S. of Hukong Valley), *Griffith 5007* j 1,600–2,600 ft. (GH, κ). Tampyu (Kachin), *Thompson* (1896) ♂ (κ). Northern Triangle, Arahku, *Kingdon-Ward 20626* j (A, BM), *21295* j (A, BM), *21393* s 4–5,000 ft. (A, BM), *21626* j (A, BM). **Thailand.** Nakhon Rachasima, *Phengkhlai 568* j (κ). Pulum Lo, Dan Sai, *Kerr 5788* ♀ 1,000 m. (BM, κ). Kao Kuap, *Kerr 17715* s 500 m. (BM, κ). Kao Soi Dao, Trang, *Kerr 19435* j 500 m. (κ). Botong, Pattani, *Kerr 7648* ♂ 600 m. (κ). **Laos.** Betw. Dasia and Cateng, Taravane Prov., *Poilane 16092* ♀ (A). Tram-la, Tranninh Prov., *Poilane 2147* j (A, κ, L). Boloven near Attopeu, *Poilane 15922* ♀ (NY). Without loc., *Alleizette* (1932) s (L). **Cambodia.** Kuang Repoe, Opong Prov., *Pierre 5528* p.p. s (in mts.) (A, κ). Sckrâl Mts., Samrongtong Prov., *Pierre 5528* p.p. j (A, κ, NY). Phnom Penh Forest, *Bejoud 718* ♂ (ILL). Elephant Ra., *Poilane 320* ♀ (A), *23118* ♀ (BM). **Tonkin.** Hayata (1917) j (A-isotype of *Podocarpus kawaii*). **Annam.** QUANG TRI PROV.: Dent de Tigre, *Poilane 10293* ♀ (A, κ, L). Bach Ma (N. of Da Nang) *Poilane 29960* ♀ (ILL). Dong-tri Massif, *Poilane 10995* j (A, L). Dong-co-pah Massif, *Poilane 11110* ♀ (A, L, NY). Without loc. *Poilane 13644* ♀ (A, κ). SOUTH: Near Dakto, *Poilane 35595* j (ILL). Dalat (Lang Bian Massif), *Evrard 1779* ♀ (A, NY), *238* j (A, NY), *Chevalier 30027* j 1,400 m. (A), *Poilane 4038* j (A). Nonh-hoa (near Nhatrang), *Poilane 6509* ♀ (A, NY). Nhatrang, *Poilane 3387* j (A, κ), *9103* j 500–1,500 m. (ILL). Chapu, *Petelot s.n.* ♀ 1,500 m. (NY). Without loc. *Delacour & Low* (1927) ♀ (BM), *Kloss s.n.* s 5,200 ft. (BM), *Vim s.n.* ♀ 1,500 m. (US). **China.** Kwangtung-Tonkin border, *Tsang 27332* j (A, κ). Chen Pien Dist, Kwangsi, *Ko 55900* j (A). Tsin Hung Shan, N. Him Yen, *Ching 7034* j 4,000 ft. (A, NY, US). Kwangsi, *Wang 39608* ♀ (A). **Hainan.** Fan Ya (5 Finger Mt.), *Chun & Tso 44250* s 4,000 ft. (A, L, NY), *McClure 8705* ♀ 700–1,000 m. (A, BM). Seven Finger Mts., *Liang 61783* j (A, NY). Dung Ka, *Chun & Tso 43955* ♀, j 2,400 ft. (A, NY). Kan-en Dist., *Lau 3556* j (A). Without loc. *McClure 18304* j 1,000–1,500 m. (NY), *18279* ♀ (NY), *How 72870* ♀ (BM), *Chun 1390* ♀ (A), *Liang 65187* j (A, NY), *65257* j near summit (A, NY, US), *Tang 438* j (A), *Wang 35591* ♀ (NY, US). **Malaya.** Kedah Peak, *Low 28* j (κ), *Kochumen 70988* j 3,200 ft. (κ, L). Penang, *Curtis s.n.* j (US). Gov't Hill, Penang, *Maingay 2239* s (κ). G. Batu Pateh, Perak, *Wray 1198* ♂ (κ). G. Benom, Pahang, *Whitmore 3268* ♀ (κ); Sungai Telom, *Strugnell 23931* j 2,800 ft. (A); Kluang Terbang, *Barnes 10907* ♀ (κ). Selanger, Pahang Track, *Ridley 8636* s 1,500 ft. (A). Fraser Hill, *Deris 22563* ♀ (κ). Batang Padang, Selangor, *Murdoch 11964* j (κ). B. Etam, Selangor, *Kekall 19814* s (κ). Malacca, Mt. Tapah, *Werner* (1912) j (z). **Sumatra.** G Pagarang, Gajo Luas, *Atmodjo 82* j (L). Dairi Lands, *Dames 57* j 1,550 m. (κ, L). Pantjurbatu (NW. of L. Toba), *Lörzing 7117* s 1,400 m. (L). NW. side of Toba L., *Bangham 1074* j 4,100–4,500 ft. (A, κ, NY), *1127* ♀ (A, κ, NY). East Coast, path Talven na Uli to Tomuan Dolok, *Boeea 10697* ♀ (A, κ, L). Siosar, *Lörzing 8627* j 1,575 m. (L). Mt. Sibajak, *Lörzing 13509* ♀ 1,000–1,600 m. (L). Karoland, Sigurunggurung, *NIFS bb5443* ♀ 1,500 m. (L). Karoland, Tongkoh, *NIFS bb28147* s (A, κ, L). Karoland, *NIFS bb2768* ♀ 1,400 m. (L), *bb7708* ♀ (L). Simelungun, *Yates 2148* j (L, NY), *Esche bb35321* s 1,200 m. (L), *Lörzing 11508* j 400 m. (L); Marehat Huta, *NIFS bb4866* j 700 m. (L). Berastagi, *Yates 1987* j (L). Mt. Singalan, Upper Padang, *Beccari 49* j 2,000 m. (FI, κ, L), *Schiffner 1473* j 1,700 m. (L), *1474* s 2,500 m. (L), *Ernst 851* j (z). Solok, *NIFS bb4130* j 1,000 m. (L). Kerintji Indrapura,

NIFS bb18752 j 1,200 m. (A, L). Sielok Daras (G. Kerintji), *Robinson & Kloss* s.n. s 3,000 ft. (K). G. Tudjuh (G. Kerintji), *Meijer* 6584 ♂ 1,500–1,700 m. (L), 7267 j 1,500–2,000 m. (L), *Jacobs* 4483 j 2,000–2,200 m. (K, L). Taram, R. Tjampo, *Meijer* 6780 j 500–1,000 m. (L). Bengkulu, Redjang, Paja Magelang, *Renwarin* bb2436 ♂ (L). Kriu, Waimengaku, *NIFS* bb8737 j 950 m. (L). Bengkulu, G. Pesagi, *Rappard* P19 j 1,700 m. (A, L). G. Pesagi, Liwa, *De Voogd* 119 s 1,800 m. (L), 134 j 1,700 m. (L). Lae Pandom, *Surbeck* 532 j 1,600–1,800 m. (L). Leaukavear, *Balten Pooll* s.n. s 1,630 m. (L). Palembang, Seminung, *Rappard* S28 s 1,800 m. (A). **Philippines.** MINDANAO: Mt. Katanglad, Bukidnon Prov., *Sulit* 9896 ♀ 1,800 m. (A, L). Lanao Prov., *Alvarez* 25176 j (A, US). Mt. Malindang, Mizamis Prov., *Mearns & Hutchinson* 4666 ♂ (K, L, NY, US). Mt. Batangan, *Warburg* 14721 j (NY). **Celebes.** Pamula dama, B. Korouë (Masamba), *NIFS* bb24951 ♀ 2,000 m. (A, L). Ululu (Masamba), *NIFS* bb24956 s 1,700 m. (A, L). Palu, Wuka Tampai Mt. (Masamba), *NIFS* bb15155 s 2,500 m. (L). Porehu (Malili), *NIFS* bb19559 ♂ 1,200 m. (A, L). **Moluccas.** Buru, Fakal, *Toxopeus* 485 j 1,100 m. (L). Morotai, *Kostermans* 1215 j 1,000 m. (A). Middle Ceram, *Stresemann* 158 j 1,000 m. (L), 354 ♂ 1,450 m. (L), 363 j 1,100 m. (L). **New Guinea.** Cycloop Mts., *Karstel* BW 5441 ♂ 510 m. (L). Terr. New Guinea, E. Highlands, Osaka, *Womersley* NGF 24928 ♀ 4,000 ft. (LAE). **New Britain.** Mt. Tangis, *Frodin* NGF 26889 j 3,000–4,500 ft. (L). **New Hebrides.** Erromanga, *Corbasson* 18123 j 200 m. (P). Aneityum, *Kajewski* 849 ♀ 500 ft. (A, NY, US, z). **Fiji.** Nandarivatu, *Gibbs* 775A & B s (BM), *Smith* 4901 j 800–900 m. (L, US), 6245 ♀ 850–970 m. (A, L, US), *Degener* 14315 ♀ (NY, US). *Gillespie* 4263 j 900 m. (NY), *Lam* 6876 ♂ 850 m. (L), *Vaughn* 3258 s (BM), *de Laubenfels* P328 ♀ 2,000 ft. (A-holotype of *Dacrycarpus imbricatus* var. *patulus*; K, RSA, SBT-isotypes), P331 j (A, RSA). Nausori Highlands, *de Laubenfels* P306 j 1,900 ft. (A, RSA). Namboutini, *de Laubenfels* P310 j 1,000 ft. (A, RSA).

From its distribution, one might guess that *Dacrycarpus imbricatus* variety *patulus* is the primitive representative of the species which has been largely displaced over much of its range by other varieties, but survives alone both on the western and the eastern parts of the range. Specimens from Fiji, when compared with specimens from Sumatra and southeast Asia, can not be distinguished. In the Philippines, Celebes, and New Guinea where overlap with other varieties occurs, specimens are difficult to identify because juvenile and transitional stages are indistinguishable and all too often are all that is collected. In the Philippines forms transitional to var. *robustus* apparently occur, while in Borneo and Celebes the very few mature specimens seem transitional between var. *imbricatus* and var. *patulus*. Several specimens from lower elevations in New Guinea do not have a robust form and have been referred to the var. *patulus*.

21c. Var. *robustus* de Laubenfels, var. nov.

Podocarpus papuanus Ridley, Trans. Linn. Soc. London. II. 9: 158. 1916.

Syntypes: *Kloss* in 1913, New Guinea, Mt. Carstensz and *Giulianetti & English* in 1897,⁶ Wharton Range.

Podocarpus leptophylla Wasscher, Blumea 4: 414. 1941. Type: *De Kock* 39, New Guinea, Mt. Goliath (not seen).

⁶ Ridley refers only to Giulianetti.

Folia brevia, patula, acuta, ad apicem incurvata, fortiter carinata, robusta, 1.2–1.8 mm. longa, 0.6–0.8 mm. lata, ramuli foliis inclusis 1.5–2.5 mm. diametro; folia involucralia 2–3 mm. longa. Holotypus: *Brass* 30568 (A), New Guinea, Mt. Wilhelm. FIG. 8c.

DISTRIBUTION. Scattered and common in moist rainforests from near sea level to 3,300 meters, but mostly 1,000 to 2,700 meters from North Borneo and the Philippines to the eastern end of New Guinea. MAP 8.

Sarawak. Mt. Poe, *Beccari* 2431 j 3,000 m. (FI), *Clemens* 20134 j summit (A, NY). Mt. Mah, *Beccari* 2812 ♀ (FI, K). **North Borneo.** Penampang, *Clemente* 5981 j 5,000 ft. (A, K, L), 6216 s (K), *Leaño-Castro* 5988 j (K, L), 5991 j 3,500 ft. (K, L). Tenompok Pass (Kinabalu), *Smythies* S10601 ♀ 4,500 ft. (K, L), *Clemens* 28631 ♂ 5,000 ft. (A, ILL, K, L, NY), 29779 j (A, K, L, NY), *Melegrito* A471 j 4,700 ft. (K, L). Pentaran Basin (Kinabalu), *Clemens* 33618 ♀ 8,000 ft. (A, K, L, NY). Masilan R. (Kinabalu), *Clemens* 51635 ♀ 8,000 ft. (A, K, L). Mt. Gedeh (Kinabalu), *Clemens* 30371 j 6–9,000 ft. (NY). Kinabalu, *Colenette* 579 s 8,000 ft. (K), *Clemens* 28954 j 8,000 ft. (BM, K), *Chew & Corner* RSNB 4084 j (K). Tiong Pass, *Keith* 5930 ♂ 5,500 ft. (K, L), 5967 j 5,300 ft. (K, L). **Philippines.** LUZON: Mt. Santo Thomas (Benguet), *Elmer* 6550 ♀ (K, NY, US), 6551 ♀ (K, NY, US), *Williams* 1298 ♀ (GH, K, NY, US), 1299 ♀ (NY). Panai (Benguet), *Mearns* 4405 ♀ 7,000 ft. (L, US), *Santos* 31817 ♀ (A, US), *Gillis* 27255 ♀ (A, US), *Sulit* 7586 ♂ (BRI). Mt. Osdung (Benguet), *Quisumbing & Sulit* 82481 j (NY). Benguet Dist., *Leaño* 20673 s (US), 20674 j (US). Lepanto Dist., *Curran* 10960 s (US), *Darling* 14498 j (L), *Vidal* 1818 s (K). Mt. Data (Lepanto), *Alcasid* 1847 ♂ (L), 1897 j (L), *Merrill* 4503 j (K, NY, US), 4546 j (K, L), *Stern* 2242 j 7,050 ft. (ILL), *Stern & Rojo* 2289 j 7–8,000 ft. (ILL), 2292 j (ILL). S. of Bontoc, *Walker* 7526 j 6,000 ft. (US). Mt. Banahao, *Barthe* (1857) s (A). MINDORO: *Merrit* 8529 j (K, NY, US). MINDANAO: Mt. McKinley (Davao), *Kanehira* 2652 j (NY), 2726 s (NY). Tupi, Mt. Matutum (Cotabato), *Sumajit* (1966) ♀ 293 ft. (L). **New Guinea.** VOGELKOP: Nettoti Ra., *Versteegh* BW 10411 ♂ 1,700 m. (L), *Van Royen & Sleumer* 7948A j 2,100 m. (L). Kebar Valley, *Van Royen* 3895 j 1,750 m. (L). Anggi Lakes, *Gibbs* 5540 ♀ 7–9,000 ft. (K), *Versteegh* BW 250 ♀ 2,000 m. (A, L), *Kostermanns* 2197 s 2,000 m. (L), *Stefels* BW 2014 j 1,860 m. (L), BW 2006 j 1,875 m. (L). Arfak Mts., Hatam, *Beccari* (1875) s 5–7,000 ft. (FI). G. Saru, Gmbai, *Stefels* BW 2038 s 1,980 m. (L). Sioriep, Ransiki Dist., *Mangold* BW 2263 ♂ 1,200 m. (K, L). Arfak Mts., *Kanehira & Hatusima* 13933 ♀ (A), 13446 s (A), *Versteegh* BW 12610 s 1,750 m. (L). WESTERN HALF: Motito (Wissel L.), *Vink & Schram* BW 8731 j 1,800 m. (L). Enarotali (Wissel L.), *Rappard* BW 698 j 1,750 m. (A, K, L). Mt. Carstensch, *Kloss* (1913) ♂ (K-syntype of *Podocarpus papuanus*; BM-isotype). Doorman Top, *Lam* 2153 j 2,550 m. (L). L. Habbema (Bele R.), *Brass & Versteegh* 11148 ♀ 2,350 m. (A, L), *Brass* 11347 s 2,300 m. (A, L). Barnhard Camp, *Brass & Versteegh* 11980 j 1,480 m. (A, L), 12522 ♀ 1,140 m. (L), *Brass* 12990 s 1,200 m. (A, K, L), 13044 ♀ 1,000 m. (A, K, L), 13084 ♂ 900 m. (A, L), 13146 ♀ 950 m. (A, K, L). Mt. Antares (Star Mts.), *Kalkman* 4465 ♂ 2,360 m. (L). Sidoarsi Mts., *Iwanggin* BW 9059 s 660 m. (L). Hellwig Mts., *Lorentz* 1699 s 2,100 m. (K, L). Cycloop Mts., *Versteegh & Koster* BW 14 s 750 m. (A, K, L). TERR. NEW GUINEA: 12 miles N. of Wabag, *Womersley* NGF 11260 ♀ 7,000 ft. (K, L), 11067 j 7–8,000 ft. (L, NSW). Wabag, *Saunders* 1048 j 7,100 ft. (L, LAE). Tambul (Mt. Hagen), *Womersley* NGF 14253 j 8,000 ft. (L). Mt. Kum (Mt. Hagen), *Womersley* NGF 9430 s 7,000 ft. (A, L, NSW). Wankl (Mt. Ha-

gen), *Hoogland & Pullen* 5868 s, j 2,300 m. (A, K, L, US). Mt. Hagen, *Cavanaugh* NGF 3322 j (A, K). L. Inim, *Flenley ANU* 2176 s 8,300 ft. (K, L). Al R. Mts. (Nondugl), *Womersley NGF* 5338 j 7,000 ft. (A, K, L, NSW), NGF 5353 j (A, K, L). Waimambuno (Chimbu), *Saunders*, 823 j 9,000 ft. (A, L). Mt. Wilhelm, *Brass* 30568 ♀ 2,650 m. (A-holotype of *Dacrycarpus imbricatus* var. *robustus*; K, L, NY, US-isotypes), 30570 j (K, L, NY, US). Chimbu, *Cavanaugh* NGF 3332 j (A, K, L), *Stauffer* 5652 j 2,600 m. (K, L, z). Fatima R., Marafunga-Chimbu Div. (Goroka), *Womersley NGF* 24563 s 7,700 ft. (K, L). Marafunga, Upper Asaro Valley (Goroka), *Womersley & Sleumer NGF* 14013 ♀ 8,200 ft. (K, L), *Anden JARA* 7 s 8,300 ft. (K). Danlo (Goroka), *Saunders* 861 j 8,500 ft. (L), 865 (L). Above Goroka, *Womersley & Floyd NGF* 6138 ♂ 8,300 ft. (A, K, L). Purosa (Okapa), *Brass* 31660 j 1,950 m. (A, L, NY, US), 31852 ♂ (A, K, L, NY, US). Wagau, *Sayers NGF* 21613 j 4,500 ft. (L). Samanzing, *Clemens* 3323 ♀ 4,600 ft. (A, z), 5473 j (A), 8848 j (A). Sarawaket, *Clemens* 5586 ♀ 7,000 ft. (A). Mt. Rawlinson, *Hoogland & Craven* 9553 ♀ 6,000 ft. (K), 9354 j (K), 9355 j (K). Wau, *Womersley & Millar NGF* 8324 s 5,500 ft. (A, L, NSW), Mt. Kaindi (Edie Creek), *McVeagh NGF* 7581 ♂ 5,850 ft. (A, K, L, NSW), *Womersley & de Laubenfels NGF* 19460 (P485) ♀ 7,500 ft. (A, K, L, RSA, SBT), *de Laubenfels* P482 j 6,500 ft. (A, K, RSA, SBT), *Brass* 29577 s 2,060 m. (L, US), 29598 s 2,250 m. (A, L, NY, US), 29599 s (A, L, NY, US), *Havel & Nauari NGF* 17134 s 7,300 ft. (K, L). Morobe Dist., *Anon. NGF* 3128 j (L). PAPUA: Anga Valley near Ebenda (S. Highlands), *Schodde* 1561 s 6,500 ft. (K, L). Alola, *Carr* 14194 ♀ 6,000 ft. (A, L, NY). Boridi, *Carr* 13264 j 4,700 ft. (A, NY). Mt. Mau, *Crutwell* 897 j (K). Murray Pass, *Brass* 4768 j 2,840 m. (NY). Mt. Scratchley, *Giulianetti* (1896) s 12,200 ft. (K). Wharton Ra., *Giulianetti & English* (1897) ♀ 11,000 ft. (K-syntype of *Podocarpus papuanus*). Mt. Tafa, *Brass* 4962 s 2,400 m. (A, NY), 5115 j (NY). Owen Stanley Ra., *Lane-Poole* 264 j 5,000 ft. (A). Sibium Ra., *Pullen* 5914 j 2,650 ft. (A, L), 5930 ♂ 3,520 ft. (A, K, L). Mt. Dayman (Milne Bay), *Brass* 22582 ♀ 2,000 m. (A, K, L), 23393 ♂ 1,700 m. (A, K, L, US).

ILLUSTRATIONS. GIBBS, L. S., *Contrib. Phytogeography and Flora of the Arfak Mountains*, t. 4. 1917, as *Podocarpus papuanus*; WASSCHER, J., *Blumea* 4: t. 4, fig. 3. 1941, as *Podocarpus papuana*.

There has been a great deal of difficulty in separating this variety, when treated as a species (*Podocarpus papuanus*), from the type (*Podocarpus imbricatus*) (Gibbs, 1917; Wasscher, 1941). When specimens of fully mature forms are placed side by side they are definitely distinct, but the various juvenile and transitional forms so often met with can not be distinguished and have been greatly confused in the herbaria. Inasmuch as the reproductive structures are essentially identical, it seems best to maintain it in varietal status. Certainly where var. *robustus* occurs, other varieties are usually rare or absent. A few mature specimens in the Philippines are more or less intermediate between varieties *robustus* and *patulus*, including *Leaño* 20673 and (see var. *patulus*) *Mearns & Hutchinson* 4666. Perhaps these two varieties tend to merge in the Philippines. Certainly typical var. *robustus* specimens have come from Borneo. Variety *robustus* differs most from the typical variety, *imbricatus*. From var. *curvulus* it differs in the same way that var. *patulus* differs from var. *imbricatus*. From var. *patulus* it differs in

the same way (except for habit) that var. *curvulus* differs from var. *imbricatus*. The status of *Podocarpus leptophylla* is uncertain as I have not seen the type. From its description it appears to belong to this species but perhaps not to this variety.

21d. Var. *curvulus* (Miquel) de Laubenfels, comb. nov.

Podocarpus cupressina var. *curvula* Miquel, Pl. Junghuhn. 1: 4. 1851. Lectotype: *Junghuhn s.n.*, Java, Mt. Prahū.

Podocarpus imbricata var. *curvula* (Miquel) Wasscher, Blumea 4: 398. 1941.

Mature foliage leaves strongly adpressed, robust, ca. 1.2–2.0 mm. long and 0.8–1.0 mm. wide, the whole foliage branch 1–1.25 mm. in diam. and drooping; involucre leaves 2.5–4.5 mm. long, more or less clasping the receptacle. FIG. 8d.

DISTRIBUTION. Generally on mountain ridges, often in solid stands and sometimes dwarfed or procumbent, from 1,350 to 3,300 meters in elevation but mostly above 2,000 meters, from Sumatra and Java. MAP 8.

Sumatra. Atjeh, Gajoland, *Van Steenis 8423* ♀ 2,100–2,250 m. (A, K, L) and ♂ (K, L, NSW). Java. Mt. Gedeh (Pengalengan), *Junghuhn s.n.* ♂ 4–7,000 ft. (L-syntype). Dieng Mts., Mt. Prahū, *Junghuhn s.n.* ♂ 5–7,000 ft. (L-lectotype). Kedec, Wonosobo, *Zwart 6517* ♀ (L). Without loc., *Junghuhn s.n.* ♀ (L), ♂ (NY), 4 j (L), *Blume s.n.* ♀ (L).

ILLUSTRATION. WASSCHER, J., Blumea 4: t. 4, fig. 2β. 1941, as *Podocarpus imbricata* var. *curvula*.

The most striking character of var. *curvulus* is its weeping habit, but herbarium specimens can be readily distinguished by their robust branches with adpressed scale leaves.

22. *Dacrycarpus vieillardii* (Parlatore) de Laubenfels, comb. nov.

Podocarpus taxodioides var. *tenuifolia* Carrière, Traité Conif. 2: 658. 1867.

Type: *Vieillard 1260*, New Caledonia, Paita (juvenile form).

Dacrydium elatum Wallich var. *compactum* Carrière, *ibid.* 693. Type: *Vieillard 1262*, New Caledonia, Paita.

Dacrydium elatum Wallich var. *tenuifolium* Carrière, *ibid.* Type: uncertain.⁷

Podocarpus vieillardii Parlatore in DC. Prodr. 16(2): 521. 1868. Type: *Vieillard 1262*.

Podocarpus tenuifolia (Carrière) Parlatore, *ibid.* (based on *Dacrydium elatum* var. *tenuifolium*) Type: *Vieillard 1260*.

Nageia vieillardii (Parlatore) Kuntze, Rev. Gen. Pl. 800. 1891.

Nageia tenuifolia (Carrière) Kuntze, *ibid.*

Tree to ca. 25 m., often much less; bark hard, slightly rough with scattered low lenticels, breaking off in small thick flakes or short strips, dark but weathering gray, brown and slightly fibrous or granular within; juve-

⁷ Apparently Carrière meant to replace this by his *Podocarpus taxodioides* var. *tenuifolia* (with the same type specimen) but failed to delete it from the manuscript.

nile leaves bilaterally flattened and distichous, up to 10 mm. long and 1.0 mm. broad, spreading and acute with a minute spine turned upward more or less parallel to the branch, smaller towards the base and apex of a branch, gradually reduced in size, thickened and losing the distichous habit; adult leaves acicular, sometimes not bilaterally flattened, straight, spreading at an angle of about 30° , acute, with a minute spine turned upward, not distichous, from 2 to at least 4 mm. long in the middle, but beginning as scales at the base of a branch growth unit, ca. 0.4–0.6 mm. wide, 0.4–0.8 mm. thick, sometimes continuing growth into additional growth units; non-foliage leaves of main shoots scale-like, appressed, bifacially flattened, at least 2 mm. long; pollen cones lateral and subtended by a short stalk with a few small scales or rarely terminal on a short branch, linear, 7–12 mm. long and 1 mm. in diam.; microsporophyll triangular and acute; seed cone on a lateral or terminal scaly shoot 6–8 mm. long, the scales 0.6–0.8 mm. long and appressed, the cone subtended by 6–10 spreading involucreal leaves 1–2 mm. long, robust, keeled, acute, the cone itself formed of a small warty receptacle 2–3 mm. long with one projecting sterile bract and one or occasionally two apical ovules; seed oval or globular, generally with a blunt double crest and somewhat elongated at the base, 4 mm. in diam., 5.5–6 mm. long.

DISTRIBUTION. Throughout New Caledonia, particularly in areas of serpentine rock, along river banks and in moist draws generally where flooding is common, from sea level to 800 meters.

New Caledonia. Mt. Paéoua, *McKee* 17029 s 600–900 m. (P). Mt. Boulinda, *McKee* 17199 j 750–850 m. (P), 17176 j (P), *Stauffer, Blanchon & Boulet* 5778 ♀ (P, Z), *Veillon* 142 j 750 m. (P). Baraua R., *McMillan* 5173 ♂ (A, K, P), *McKee* 2547 s (P), *MacDaniels* 2290 s (P), *Guillaumin* 13345 s (P, Z). Ouen Koura Valley (Upper Douthio), *McKee* 13671 s 300–400 m. (P). W. of Mes-sioncoué near Port Bouquet, *Balansa* 2502 s (P). Combui R., *Compton* 2227 ♀, j (BM). Kalouehola (Tontouta), *Däniker* 587 s (Z). Upper Ouinné R., *Bernier* 259 s 600–800 m. (P), *Baumann-Bodenheim & Guillaumin* 12834 s 800 m. (P, Z). Canloëthe Mts., *Caldwell s.n.* j (K). Paita, *Vieillard* 1262 ♂ (P-holotype of *Podocarpus vieillardii* and of *Dacrydium elatum* var. *compactum*), 1260 j (P-holotype of *Podocarpus tenuifolia* and of *Podocarpus taxodioides* var. *tenuifolia*; BM, K-isotypes). Couvelée R., *Balansa* 1382 ♂ (K, NY, P), *Franc* 2418 ♀ (A, K, NY, P, Z), 2419 ♂ (A, K, NY, P, Z). Dumbea R., *Balansa* 181 ♀ (K, P), *Pancher s.n.* ♀ (BM, P), *White* 2112 ♀ (A), 2285 s, j (A, K, P), *Franc* 35 j (K, P), *Bernier* 69 s (P), 205 j (P), 253 j (P), 257 ♂ (P), *Buchholz* 1140 s (ILL, K, P), 1146 ♂ (ILL, K, P), *Hürlimann* 1040 s (P, Z), *McKee* 2353 ♂ (P), 2567 ♂ (P), 3353 ♂ (K, P). Mt. Koghis, *Brousmiche* (1882) ♀ (P), *Le Rat* 2372 j (A). Mine Werguin (base of Pic du Rocher), *Virost* 206 ♂ 200 m. (A, ILL, NY, P). Unia, *Vieillard* 1261 j (P). R. Bleue, *Foster* 202 j (P), *Sarlin* 244 j (P), *Hürli-mann* 1533 s (P, Z), *de Laubenfels* P389 ♀ 165 m. (A, K, RSA), P389a j (A, RSA), P444 ♂ 160 m. (A, RSA), *Baumann-Bodenheim* 15040 s (P, Z), 15041 s (P, Z), *Aubréville & Heine* 182 s (P). R. Blanche (Upper Yaté), *Bernier* 206 s (P), *Anon.* 241 s (P), *Buchholz* 1349 ♀ (ILL, K, P), 1425 ♀ (ILL, K, P), 1464 s (ILL, K), 1465 s (ILL, K, P), 1553 ♀ (ILL, P), 1708 ♀ (ILL, K, P), *de Laubenfels* P111 s (SBT), *Baumann-Bodenheim & Guillaumin* 10843 ♀ (P, Z). Mare Kiki,

Hürlimann 3109 j (z), 3158 ♂ (z), 3159 j (z). Canyon of Yaté R., *Bernier* 254 j (P), 255 s, j (P), 256 j (P), 258 ♀, j (P). Plaine des Lacs, *McKee* 1142 ♀ (A). Prony, *Le Rat* 222 j (P), 1719 s (P). Southwest, *Moore* 4 ♂ (K). Without loc. *Balansa s.n.* ♀ (BM, K), *Pancher* 4 s (P), *Mueller* 68 s (P), *Sarlin* 237 s (P), 341 s (P), *Baudouin* 335 j (P).

ILLUSTRATIONS. PILGER, R., *Pflanzenreich* IV. 5 (Heft 18): fig. 7F. 1903; *Nat. Pflanzenfam.* ed. 2. 13: fig. 124F. 1926; SARLIN, P., *Bois et Forêts de la Nouvelle-Calédonie*, t. 25. 1954, all as *Podocarpus vieillardii*.

The elongated pollen cones distinguish *Dacrycarpus vieillardii* from other species except *D. dacrydioides* (the pollen cones of *D. steupii* are not known). The leaves of *D. dacrydioides* are far shorter than those of *D. vieillardii* and the pollen cone is normally terminal rather than lateral. The leaves of *D. steupii* are shorter and more spreading while the involucreal leaves are longer than the foliage leaves, opposite to the condition in *D. vieillardii*. The species with leaves resembling those of *D. vieillardii* have much longer involucreal leaves and sharply spreading and not imbricate foliage leaves. The low elevation river-bank habitat is also a unique character.

23. *Dacrycarpus steupii* (Wasscher) de Laubenfels, comb. nov.

Podocarpus steupii Wasscher, *Blumea* 4: 405. 1941. Type: NIFS bb22857, Celebes, Rantelmo (not seen).

Tree to 36 m. but usually much less; bark brown or gray, inner bark pink, peeling in thin strips; juvenile leaves bilaterally flattened and distichous, up to 8 mm. long and 0.9 mm. thick, becoming shorter and not distichous, transitional leaves (sometimes fertile) variable in length, the longest in the middle of a shoot, 3–4 mm. long, acicular, tip pungent but turned upward parallel to the branch, becoming more constant in size at 2 or 2.5 mm. in length as a mature form, strongly keeled on the sides and back and spreading at an angle of 60° or more from the stem; leaves on non-foliage branches lanceolate, bifacially flattened, almost appressed, 2–3 mm. long; pollen cones unknown; seed cone on a short leafy lateral shoot 3–5 mm. or more long, the involucreal leaves at the base of the cone elongated and becoming widely spreading as the seed develops, 3–5 mm. long, the cone made up of a small warty receptacle 2–3 mm. long with a sterile bract protruding on one side, one or two terminal bracts fertile; seed globular with a small crest, 5–6 mm. long and 4.5–5 mm. in diameter.

DISTRIBUTION. Locally common but widely dispersed on high wet peaks or in bogs from 1,000 to 3,420 meters in elevation, mostly 1,600 to 3,000 meters, from Borneo to eastern New Guinea. MAP 9.

Borneo. Peak of Balikpapan, *Kostermans* 7350 ♀ 1,000 m. (A, K, L). **Philippines.** Luzon, Benguet, *Curran* 10829 s (L). **Celebes.** ENREKANG: near Pintalon, spur of Pokapindjang, *Eyma* 572 ♀ 2,350 m. (A, BRI, K, L). Tinabang, W. side of Rante Mario, *Eyma* 675 ♀ 3,000 m. (A, BRI, K, L, LAE), 778 j (K, L),

Manado: Palu, E. of Linden Sea, *Blumbergen* 3976 s 2,250 m. (A, L), 3977 j (L). **New Guinea.** VOGELKOP: Aifat Valley, *Moll BW* 12820 s 860 m. (L), 12840 ♀ 920 m. (L), 12876 s 1,050 m. (L). WESTERN HALF: Wissel L., *Eyma* 5101 s 1,750 m. (A, K, L). Kadaitadie, E. of Motito, Wissel L., *Vink & Schram BW* 8667 s 1,900 m. (L, LAE). Baliem R., *Brass & Versteegh* 11187 ♀ 1,600 m. (A, K, L, LAE). TERR. NEW GUINEA: Wabag near L. Inim, *Flenley ANU* 2175 s (K, L), 2769 ♀ 8,300 ft. (K, L). Aiyura, *Womersley NGF* 4428 ♀ 6,000 ft. (A, BRI, K, L, LAE). Sattleberg, Sambanga, *Clemens* 7258 s 5,000 ft. (A), 7562A s (A), 7902B ♀ 6,000 ft. (A). Mt. Amungwiwa, S. of Wau, *Womersley NGF* 17939 s 11,400 ft. (L). PAPUA: Ialibu, L. Buneh (S. Highlands), *Pullen* 2716 ♀ 6,950 ft. (BM, L, LAE), 2716A j (L). Uriko, road from Woitape to Kosipi (Cent. Div.), *Van Royen NGF* 20289 ♀ 6,500 ft. (K, L).

ILLUSTRATION. WASSCHER, J., *Blumea* 4: t. 4, fig. 4. 1941, as *Podocarpus steupii*.

The preference for wet conditions which appears to characterize this species probably explains why it is only occasionally found over its broad range. Many specimens have been filed with other species. Sterile specimens are distinguished by the short spreading acicular leaves becoming nearly uniform in size on mature specimens. The leaves are generally shorter and less (or not at all) bilaterally flattened than for comparable stages of *Dacrycarpus cumingii*. On the other hand the leaves of *D. compacta* are short and uniform but differ in being distinctly bifacially flattened, fairly broad, and nearly appressed. The seed cones in each case give positive identification. The one specimen from the Philippines is somewhat uncertain because it is sterile and more or less juvenile.

24. *Dacrycarpus cumingii* (Parlatore) de Laubenfels, comb. nov.

Podocarpus cumingii Parlatore in DC. Prodr. 16(2): 521. 1868. Lectotype: *Cuming* 803, Luzon, Mt. Banahao.

Nageia cumingii (Parlatore) Kuntze, Rev. Gen. Pl. 800. 1891.

Podocarpus imbricatus Blume var. *cumingii* (Parlatore) Pilger, Pflanzenreich IV. 5 (Heft 18): 56. 1903.

Tree to at least 20 m.; juvenile leaves bilaterally flattened and distichous, up to 12 mm. long and 1.2 mm. thick, the tip curved and parallel with the branch, soon losing the distichous habit and becoming coarser; mature foliage leaves bilaterally flattened, spreading, somewhat falcate, acute with a fine spine curved upward, strongly variable in length, the longest in the middle of a branch unit, 6 mm. long and 0.6 mm. thick; leaves on non-foliage branches bifacially flattened, lanceolate, nearly appressed, 2–4 mm. long and 0.6 mm. wide; pollen cones lateral on short shoots 2–5 mm. long, oval, 8–10 mm. long and 2–3 mm. in diam., microsporophylls lanceolate; seed cone on a short, usually lateral shoot 6–10 mm. long or more, leaves elongated greatly at the base of the cone so that the curving involucre leaves surround even the mature seed, the longest at least 10 mm. long and 0.5 mm. thick, the cone formed of a small warty receptacle 2–3 mm. long with one or rarely two apical fertile

bracts; the mature seed with a distinct asymmetrical crest, 4.5–5 mm. in diam. and 5–6 mm. long.

DISTRIBUTION. In mountain forests up to 3,000 meters in the Philippines, Borneo, and (according to Wasscher, 1941) in Sumatra. MAP 10.

Sarawak. Mt. Penrissen, S. of Kuching, *Jacobs* 5017 ♀ 1,400 m. (K, L, US). **Philippines.** LUZON: Mt. Polis (Mountain Prov.), *Steiner* 2207 s 2,040 ft. (L). Mt. Pulog (Benguet), *Curran, Merritt & Zschokke* 18049 ♀ (L), *Ramos & Edaño* 45005 s (A), *Steiner* 2032 j 2,400 m. (L). Mt. Banahao (Tayabas), *Cuming* 803 ♀ (A-lectotype; F, K, L-isotypes), *Foxworthy* 2387 ♂ (L). *Loher* 7137 ♀ (K, US), 7138 ♂ 2,250 m. (K), *Curran & Merritt* 7886 ♀ (NY, US), *Ramos* 19557 s (US), *Klemme* 66 ♂, j (A), 874 ♀ (NY, US), *Whitford* 951 ♀ (K, NY, US), *Holman* 4 ♀ (A), *Vidal* 623 ♀ (A, K, L), *Barthe* (1857) ♀ (A-syntype), *Ocampo* 27926 s (A), *Robinson* 5656 ♀ (BRI), *Sulit* 30051 s (BRI). Lucban (Tayabas), *Elmer* 7465 ♀ (A, K, L, z). Mt. Mahaihai (Luconia), *Wilkes s.n.* s (GH). Central Luzon, *Loher* 4852 ♀ (A, K, US). Without loc. *Loher* 2138 s, j (US). MINDORO: Mt. Halcon, *Merrill* 5563 s (NY). PANAY: Mt. Midiaas (Antique), *Yoder* (1905) ♀ (L). NEGROS: Canlaon Volcano along lake (E. Negros), *Edaño* 21935 j 1,860 m. (L), 21944 j (L). MINDANAO: Mt. Apo (Davao), *Elmer* 11684 ♀ (A, K, L, NY, US, z). Mt. McKinley (Davao), *Edaño* 993 s (A).

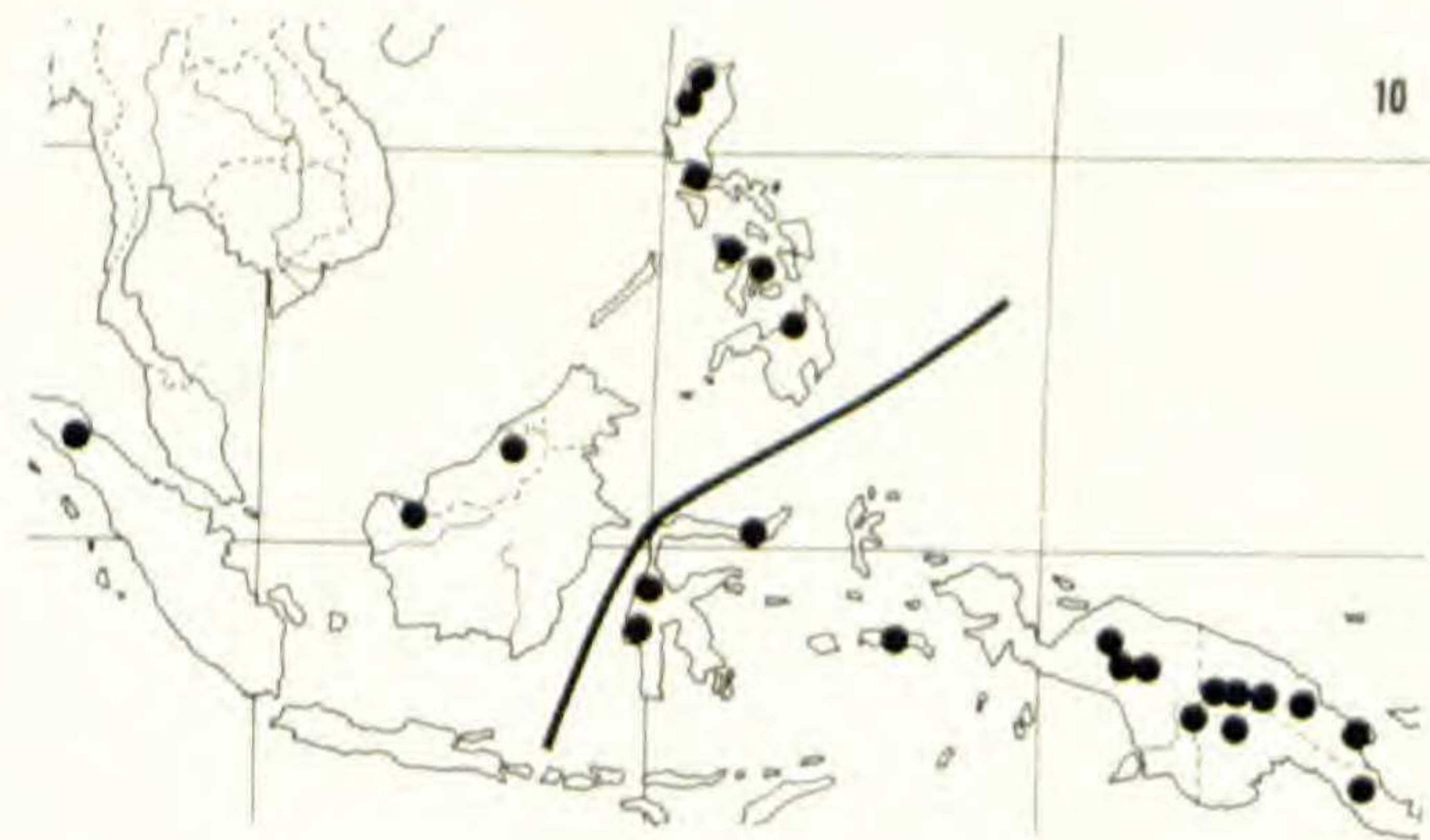
ILLUSTRATION. WASSCHER, J., *Blumea* 4: t. 4, fig. 5. 1941, as *Podocarpus cumingii*.

The long involucre leaves are the most distinguishing character of this species, being approached only by *Dacrycarpus cinctus* which has very different leaves. The bilaterally flattened mature foliage leaves are the same as *D. kinabaluensis* but not as robust. Juvenile leaves of *D. steupii* resemble mature leaves of *D. cumingii*.

25. *Dacrycarpus kinabaluensis* (Wasscher) de Laubenfels, stat. nov.

Podocarpus imbricatus Blume var. *kinabaluensis* Wasscher, *Blumea* 4: 400. 1941. Type: *Clemens* 27854, North Borneo, Mt. Kinabalu.

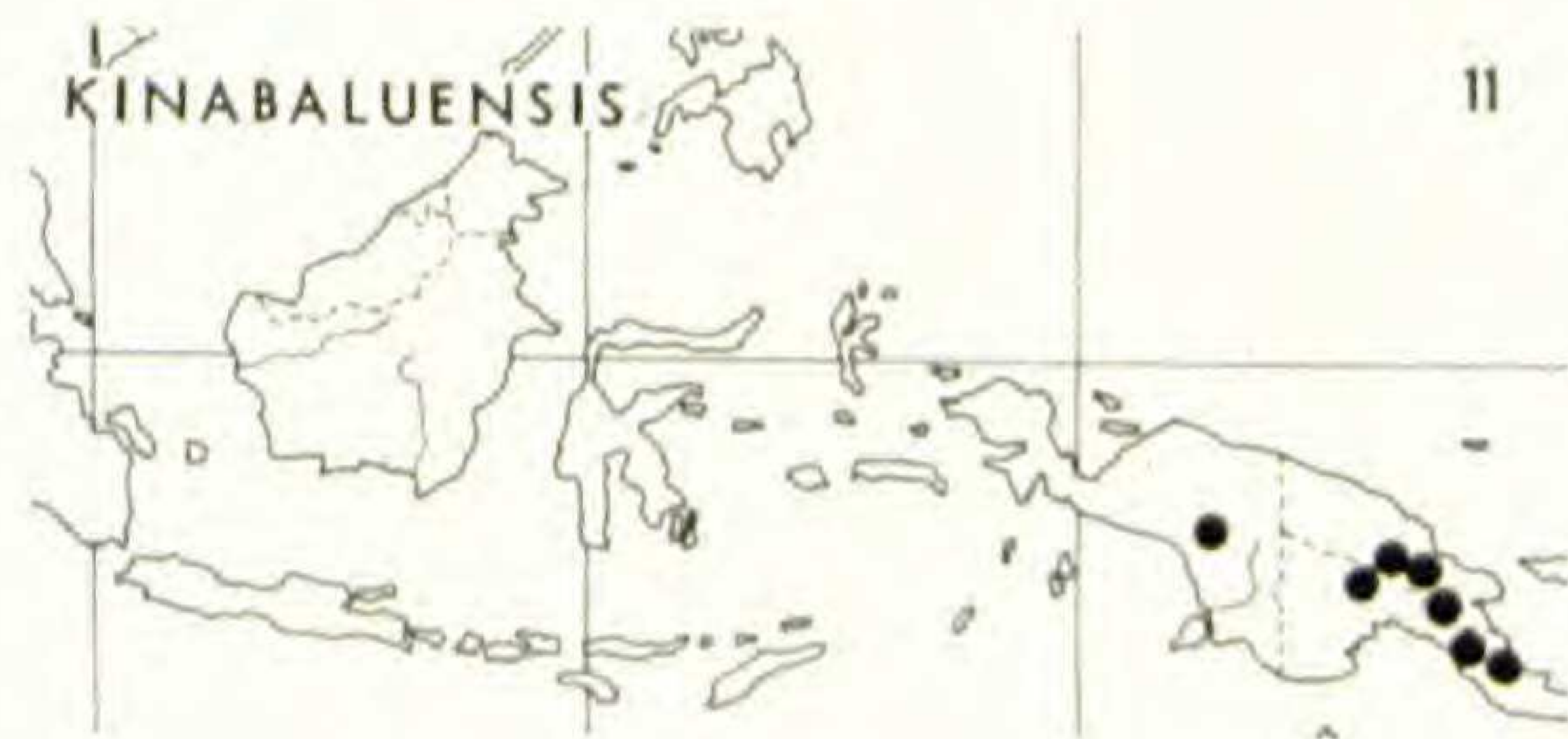
Small tree or shrub down to 2 m. high; juvenile leaves bilaterally flattened and distichous at first, at least 10 mm. long and 1.2 mm. thick, falcate with a long upturned acuminate apex; mature foliage leaves bilaterally flattened, robust (stiff), falcate, spreading at about a 30° angle, strongly curved upwards at the apex and pungent, the spine not projecting, markedly variable in length, becoming reduced on older plants so that the longer spreading leaves may be as short as 2 mm., 0.5 mm. thick, and nearly quadrangular in cross section; leaves on non-foliage branches bifacially flattened, lanceolate and pungent, curved upwards, 1–2 mm. long and 0.5–1.0 mm. wide, the size varying with the robustness of the branch but not within a given branch; pollen cones lateral on a short branchlet about 3 mm. long, globular, 8 mm. long and 3 mm. in diam.; seed cone on short lateral or terminal shoots 5–15 mm. long and bearing, as is usual for the genus, the non-foliage type leaves; at the base of the cone the leaves elongated to the size of foliage leaves



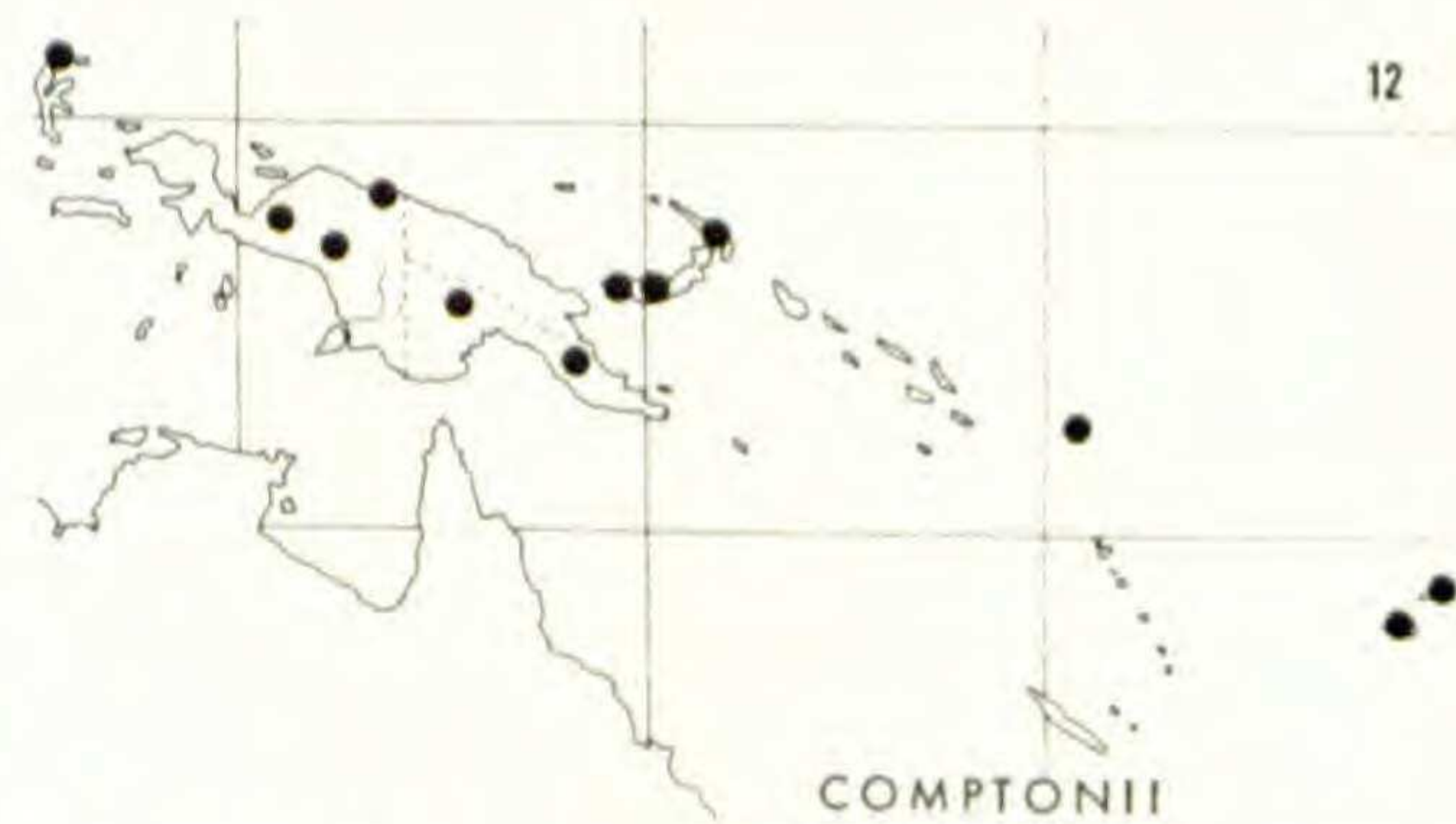
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COMPTONII



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MAPS showing distribution of: 10, *Dacrycarpus cumingii* (Parlatore) de Laubenfels (dots west of line), and *D. cinctus* (Pilger) de Laubenfels (east of line); 11, *D. compactus* (Wasscher) de Laubenfels (dots), *D. kinabaluensis* (Wasscher) de Laubenfels, known only from N. Borneo; 12, *Decussocarpus vitiensis* (Seemann) de Laubenfels (dots), *D. comptonii* (Buchholz) de Laubenfels, known only from New Caledonia; 13, *D. wallichianus* (Presl) de Laubenfels; 14, *D. fleuryi* (Hickel) de Laubenfels (dots north of line), *D. motleyi* (Parlatore) de Laubenfels (dots south of line); 15, *D. nagi* (Thunberg) de Laubenfels.

and nearly surrounding the young ovule but not reaching beyond the middle of the ripe seed, up to 7 mm. long and 1.0 mm. thick, the cone made up of a small warty receptacle 2–4 mm. long with one or two sterile protruding bracts and an apical fertile bract; the mature seed with a distinct asymmetrical crest, 5–5.5 mm. in diameter and 7 mm. long.

DISTRIBUTION. In mountain dwarf forests sometimes forming almost pure stands on Mt. Kinabalu from 2,750 to 4,000 meters at the timberline.

North Borneo. Mt. Kinabalu, Paka Cave area, *Clemens* 10636 ♀ (A, GH, K), 10662 ♀ (A), 10686 s (A), 27092 s 13,000 ft. (A, K, L, NY), 27854 ♀ (A, K, L-isotypes), 28910 ♀ 11,000 ft. (A, K, L, NY), *Wood & Wyatt-Smith SAN A4493* s 10,500 ft. (A, BRI), *Meijer SAN 21988* ♀ 9,500–11,000 ft. (K), *SAN 29265* ♂ 10,000 ft. (K). Mt. Kinabalu, Marai Parai, *Clemens* 32316 ♀ 10–11,000 ft. (A, K, L, NY), 32317 ♀ 11,000 ft. (A, L, NY), 32318 j 11,000 ft. (A, L, NY). Mt. Kinabalu, Gurulau Spur, *Clemens* 51201 ♀ (L). Mt. Kinabalu, side of Granite Dome, *Clemens* 29914 ♀ 12,500 ft. (K, L); S. slope, *Jacobs* 5755 ♀ 3,600 m. (K, L, US). Mt. Kinabalu, *Clemens s.n.* ♀ 11,000 ft. (BM), *Nicholson SAN 17825* ♀ 10,000 ft. (BRI, K, L), *SAN 39766* ♀ 9,000 ft. (K), *Sinclair & Kadim 9146* ♀ 10,700 ft. (K, L), *Haviland 1094* j 11,000 ft. (K), 1095 ♀ 11,000 ft. (A, K), *Chew & Corner RSNB 868* ♀ 10,500 ft. (K), *RSNB 5887* ♀ 9–11,000 ft. (K), *Gibbs 4216* ♂ 12,000 ft. (K), *Anderson S27079* ♀ 11,300 ft. (K).

ILLUSTRATION. WASSCHER, J., *Blumea* 4: t. 4, fig. 2γ. 1941, as *Podocarpus imbricata* var. *kinabaluensis*.

The robust form of this high-elevation species is characteristic of conifers in such places, and in general habit *Dacrycarpus kinabaluensis* resembles *D. compactus* from high mountains in New Guinea, although in detail their leaf form is, of course, quite different. *D. kinabaluensis* is most closely related to *D. cumingii*, differing in the markedly robust foliage leaves and distinctly shorter involucre leaves. The pollen cones also differ somewhat in shape. Perhaps it could be treated as a variety of *D. cumingii* but not, certainly, of *D. imbricatus*.

26. *Dacrycarpus cinctus* (Pilger) de Laubenfels, comb. nov.

Podocarpus cinctus Pilger, Bot. Jahrb. 69: 253. 1938. Type: *Clemens* 5261, New Guinea, Busu River.

Podocarpus dacrydiifolia Wasscher, *Blumea* 4: 410. 1941. Type: *NIFS bb13633*, Celebes, Pawreang Mts.

Shrub of less than 4 m. to a tree up to 30 m. high; bark brown to black, hard and uneven, inner bark reddish, breaking off in rough scales or plates; juvenile leaves slightly bilaterally flattened and distichous at first, the longest 12 mm. long and 0.8 mm. thick, falcate and bending upward to the pungent tip, gradually changing to resemble the mature leaves; mature foliage leaves of uniform size on a branch, slightly bifacially flattened, lanceolate, falcate, eventually reduced to 2–3 mm. in length and spreading

at an angle to give the branch system a diameter of 3–4 mm., about 0.4–0.6 mm. wide, mature specimens including leaf sizes ranging up to 5 mm. in the center of a branch unit, often glaucous; leaves of non-foilage branches the same or more distinctly bifacially flattened, pollen cones terminal or lateral on a very short branch 2–3 mm. long, globular or oval, 4–10 mm. long and 2–3 mm. in diam., microsporophylls acuminate; seed cone lateral on a short branch or terminal, 5–15 mm. long, involucre leaves much longer than foliage leaves and clasping the young seed but generally not reaching past the middle of the mature seed, the longest 6–7 mm. long, the cone formed by a small warty receptacle 3–4 mm. long, with one or two projecting sterile bracts, seed and receptacle becoming red when ripe; mature seed with a small asymmetrical crest, 6–7 mm. in diam. and 6–7 mm. long. FIG. 9a.

DISTRIBUTION. Mountain forests to high mountain shrubbery from 900 to 3,600 meters but mostly 2,200 to 3,200 meters, from the Celebes to the high mountains of New Guinea. MAP 10.

Celebes. Masamba, *NIFS bb24958* s 900 m. (L). Pawreang Mts., Ulu Salu (Upper Binuang), *NIFS bb13633* ♀ 1,800 m. (L-holotype of *Podocarpus dactylofolia*). Pinapuang (Manado), *Eyma 3873* s (L). **Ceram.** G. Sofia, Central Mts., *Stresemann 125 j* 1,300 m. (L). G. Pinaia, Middle Ceram, *Eyma 2276* s 3,030 m. (L), *Stresemann 251* s 3,010 m. (L), *276a j* 2,530–2,750 m. (L). **New Guinea.** **WESTERN HALF:** Mamberamo R. (Mt. Doorman), *Lam 1773* ♀ 3,260 m. (L). Hellwig Mts., *Pulle 964* ♀ 2,600 m. (K, L), *van Römer 736* s (L). Lake Habbema, *Brass 10513* ♀ 2,800 m. (A, K, L), *10514 j* (A, L), *10675* ♀ 3,000 m. (A, K, L), *Brass & Versteegh 10447* ♀ 2,840 m. (A, L). L. Quarles, *Versteegh BW2537* s 3,600 m. (K, L). **TERR. NEW GUINEA:** Wapu R. (Wabag), *Hoogland & Schodde 7166* s 9,500 ft. (A, L). Tomba, Mt. Hagen–Wabag Road, *Flenley ANU 2819* ♀ 8,900 ft. (K, L), *Robbins 238* ♀ 8,000 ft. (A, K, L, LAE, US). Lai Valley (Wabag), *Robbins 3112* ♀ 7,500 ft. (A). Minj-Nona Divide, *Pullen 5052* ♀ 10,600 ft. (L), *5267* s 9,500 ft. (K, L). Keglsugl (Chimbu), *Saunders 804* s 8,000 ft. (L, LAE). Toromambuno Mission (Upper Chimbu), *Pullen 313* ♀ 9,000 ft. (A, BRI, K, L, LAE, US), *313A j* (K, L, LAE). Mt. Wilhelm Track, Chimbu Valley, *Robbins 673* ♀ 9,000 ft. (A, BM, L, LAE). Mt. Wilhelm, *Brass 30412* s 2,770 m. (A, K, L, NY, US), *30707* ♀ 3,180 m. (A, K, L, LAE, NY, US), *Stauffer 5670* ♂ 3,250 m. (z). Kerigomna Camp (Goroka), *Hoogland & Pullen 5574* ♂ 3,000 m. (A, BRI, K, L, US). Matalunga near Goroka, *Vink NGF 12430* ♀ 7,500 ft. (L, LAE). Marafunga (Goroka), *Womersley NGF 14018* ♀ 8,200 ft. (K, L, LAE), *NGF 24569* ♀ 7,700 ft. (K), *Havel NGF 17417* ♀ 8,000 ft. (LAE), *Hartley TGH 13263* ♀ 8,600 ft. (A, L), *Tuckwell W1553* s 8,400 ft. (LAE), s.n. ♂ 8,000 ft. (LAE). Finisterre Range, E., *Pullen 6116 j* 8,100 ft. (L). Mannasat, Cromwell Mts., Huon Penins., *Hoogland 9386* ♀ 7,600 ft. (A, K, L), *9478* s (K), *9479 j* (K). Busu R. (Mt. Sarawaket), *Clemens 5261* ♀ 9,000 ft. (A, LAE-iso-types of *Podocarpus cinctus*). Mt. Sarawaket, *Clemens 5562* ♀ 8–9,000 ft. (A, LAE), *5588* s (LAE), *6283* ♀ 7–8,000 ft. (A, LAE), *7559* ♀ 6–8,000 ft. (A). Rawlinson Range, *Clemens 12332 j* 7–12,000 ft. (A). Samanzing, *Clemens 9387* ♀ 7–8,000 ft. (A, L). **PAPUA:** Mt. Kerewa, *Kalkman 4796* s, j 2,940 m. (L). Pass betw. Mt. Kerewa and Mt. Ne, *Vink 17188 j* 2,890 m. (L). Mt. Ne, *Vink 17242* ♀ 2,880 m. (L). Mt. Giluwe, above Klareg, *Schodde 2021* ♀ 8,800 ft. (K, L, LAE), *2104 j* 9,100 ft. (L, LAE). Woitapi-Kosipi Road (Cent. Div.), *Van Royen NGF*

20309 ♀ 6,300 ft. (K, L). Murray Pass, Wharton Range, Brass 4688 ♀ 2,840 m. (A, K, L, NY, US).

ILLUSTRATIONS. WASSCHER, J., *Blumea* 4: t. 4, fig. 6, as *Podocarpus cincta*, and fig. 7 as *Podocarpus dacrydiifolia*. 1941.

Confusion has existed between this species and *Dacrycarpus compactus* with which it overlaps in range, although they are not at all the same. The involucral leaves of *D. cinctus* are long and narrow, clasping the smaller seed, while those of *D. compactus* are short and triangular, barely reaching the base of the distinctly larger seed. Foliage leaves contrast in the same way. The terminal position of the pollen cone which is usual in *D. cinctus* is a character shared only with *D. compactus* and *D. dacrydioides*. The essential non-dimorphic quality of the mature foliage is shared only with *D. compactus*, *D. expansus*, and *D. imbricatus* (in part). There are several specimens of *D. cinctus* which differ from the typical form in the direction of *D. compactus* and could, perhaps, be recognized as forming a variety (FIG. 9b). These are: Brass 4688, 10513, 10514, 10675, Brass & Versteegh 10447, Versteegh 2537, Pulle 964, Hoogland & Pullen 5574, Pullen 5052, 5267, Lam 1773, Schodde 2021, 2104, van Römer 736, Vink NGF 12430, and Womersley NGF 14018. They differ in that the foliage leaves are somewhat broader (up to 0.8 mm.), as are the involucral leaves (up to 1.0 mm wide). The possibility exists that these are hybrids, being found at and not far below the lower elevation limit of *D. compactus*.

27. *Dacrycarpus expansus* de Laubenfels, sp. nov.

Arbor ad 25 m. alta; cortex squamosus. Folia plantarum iuvenilium dimorpha, ad ramulos breves compressa bilateraliter, patentia, falcata, pungentia, ad 12 mm. longa, 1.5 mm. lata, biseratim expansa; ad ramulos magis elongatos compressa bilateraliter, imbricata, lanceolata, pungentia, ad 4 mm. longa, in basi 0.8 mm. lata; folia plantarum adultarum compressa bifacialiter, expansa, falcata, acuta, dorso carinata, 2-4 mm. longa, 0.6-1.0 mm. lata. Strobili masculi laterales ad ramusculis 1-2 mm. longis, ovoidei, 6 mm. longi, 3 mm. crassi. Strobili feminei ad apicem ramulorum saepe brevi 4-5 mm. longi, foliis parvis; folia involucra longiora, 3-4 mm. longa, 0.6 mm. lata; receptaculum parvulum, verruculosum, 2-3 mm. longum; semen globosum, cristatum, 4 mm. diametro, 5-6 mm. longum. Holotypus: Hoogland & Schodde 7463 (L), New Guinea, Yobobos Grassland. FIG. 7b.

DISTRIBUTION. Locally common in disturbed forests in the highlands of New Guinea at 2,600-2,670 meters.

New Guinea. TERR. NEW GUINEA: Yobobos Grassland, Laiagam Subdistrict (Wabag), Hoogland & Schodde 7463 ♀ 8,500 ft. (L-holotype; BRI, LAE-isotypes), 7440 s (L, LAE), 7682 j (L, LAE), Robbins 3214 ♂ 8,700 ft. (BRI, L, LAE). PAPUA: E. foot of Mt. Ambua, Tari Subdist., Vink 17502 ♀, ♂ 2,670 m. (L), 17499 j (L), 17500 j (L), 17501 j (L).

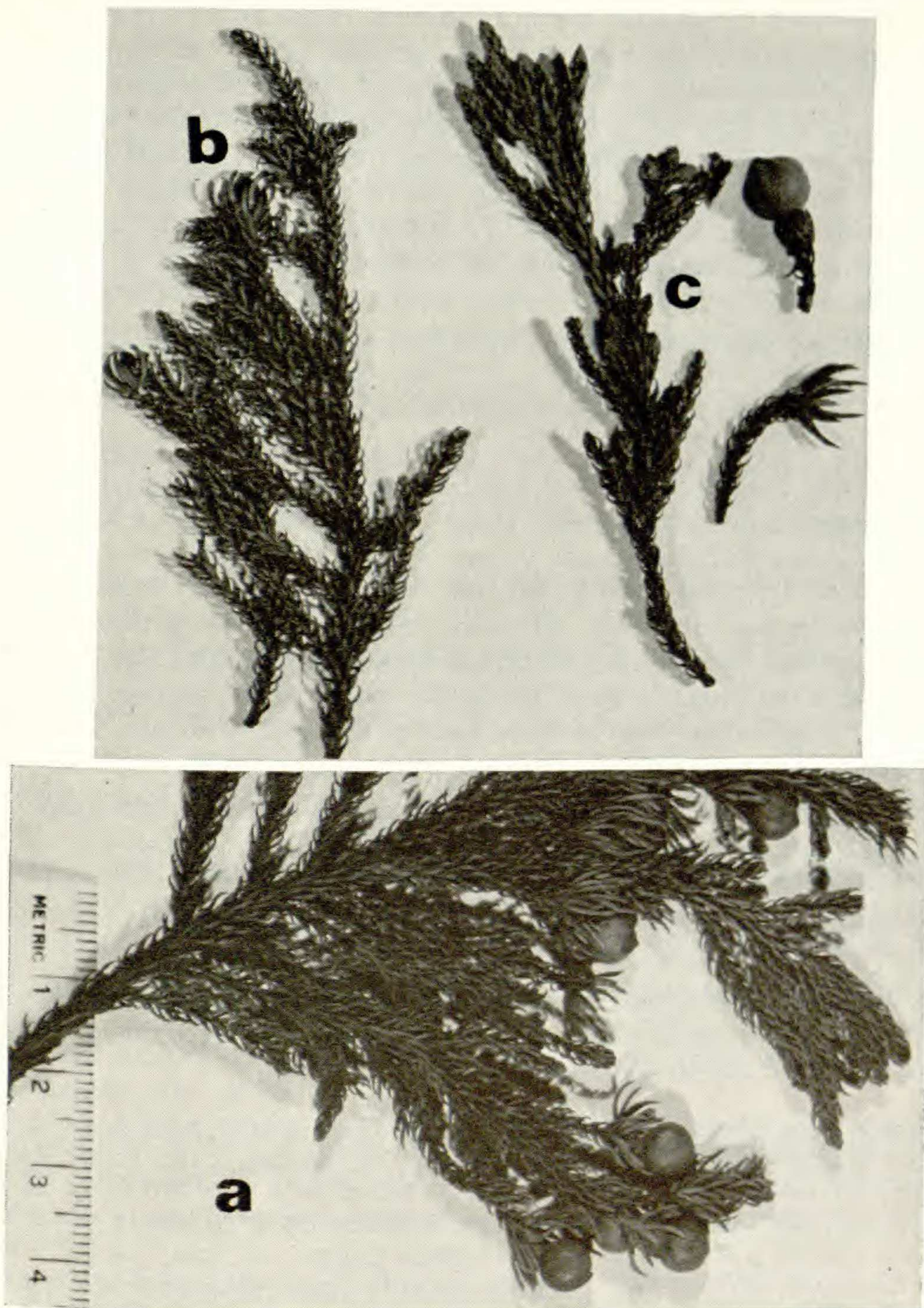


FIGURE 9. a, *Dacrycarpus cinctus* (Pilger) de Laubenfels, portion of Hartley 13263 (A), typical form of the species; b, *the same*, fragments showing variation toward *D. compactus*; c, *D. compactus* (Wasscher) de Laubenfels, fragments.

The short distinctly bifacially flattened involucral leaves clasping the receptacle, but not the somewhat small seed, distinguish this new species from all others in the genus. The only other species which have distinctly bifacially flattened involucral leaves are *Dacrycarpus cinctus* and *D. compactus*. Those of *D. cinctus* are twice as long, clasping the seed,

while those of *D. compactus* are up to twice as broad below a much larger seed. As in both of these species, *D. expansus* lacks dimorphic foliage when mature, contrasting in appearance because of the strongly spreading rather than imbricate leaves which are also distinctly broader than those of *D. cinctus*. The normally lateral pollen cones also distinguish *D. expansus* from these two species. Except for the great contrast in shape of the involucre and foliage leaves *D. expansus* resembles *D. steupii* in gross morphology, differing in habitat preference.

28. *Dacrycarpus compactus* (Wasscher) de Laubenfels, comb. nov.

Podocarpus compacta Wasscher, Blumea 4: 411. 1941. Type: Brass 4284, New Guinea, Mt. Albert Edward.

Small tree 2–15 m. high; bark hard, rough, warty, dark gray, breaking off in scales, inner bark reddish straw color; juvenile leaves bilaterally flattened, lanceolate, falcate and curved upward at the tip, acute, strongly keeled laterally, not distichous, 2.5 mm. long and 0.6 mm. thick; mature foliage leaves not dimorphic, bifacially flattened, spreading slightly, falcate, lanceolate, pungent, keeled on the back, 2–3 mm. long, 0.6–1.0 mm. wide (the wider probably on older plants); pollen cones lateral on a short branch about 3 mm. long or more usually terminal, 7–8 mm. long and 3 mm. in diam., microsporophylls lanceolate, acute; seed cone terminal, generally on a short branch 6–17 mm. long, involucre leaves robust, 4–5 mm. long and 0.8–1.2 mm. wide, clasping the receptacle, the cone itself made up of a small warty receptacle 3–4 mm. long with a sterile bract protruding; seed globular, with a blunt crest, 7–8 mm. long and 7 mm. in diam. FIG. 9c.

DISTRIBUTION. In high mountain forests and shrubberies often as an emergent, and sometimes the dominant tree at the tree line in New Guinea, from 3,200 to 3,900 meters. MAP 11.

New Guinea. WESTERN HALF: L. Habbema, Brass 9291 ♀ 3,225 m. (A, K, L), 21104 ♀ 3,225 m. (A). TERR. NEW GUINEA: Mt. Kinkain, Cent. Kubor Range (Minj), Saunders 708 ♀ 11,800 ft. (A, L), Pullen 5111 ♂ 11,770 ft. (A, K, L), 5138 ♀ 12,000 ft. (K, L). Mt. Wilhelm, Robbins 718 ♀ 12,000 ft. (L), Brass 29861 ♀ 3,650 m. (A, K, L, NY, US), 29935 ♀ 13,100 ft. (A, K, L, NY, US), s.n. s 3,320 m. (US), Millar NGF 14671 ♀ 12,000 ft. (K, L), Womersley NGF 8852 ♀ 11,870 ft. (A, K, L), 8861 ♂ (A, K, L), Pullen 338 ♀ 12,500 ft. (A, L), Hoogland & Pullen 5650 ♂ 11,700 ft. (A, BRI, K, L, US), 5703 ♀ 12,500 ft. (A, BRI, K, L, US), Havel NGF 17421 ♀ 11,500 ft. (K), Stauffer 5670 ♂ 3,250 m. (K, L), Balgooy 287 ♀ 3,650 m. (L). Mt. Otto (E. Highland), Brass & Collins 31021 ♀ 3,460 m. (A, K, L, NY). Mt. Piora, Kaimantu Subdiv. (E. Highland), Henty & Carlquist NGF 16566 ♀ 10,500 ft. (K, L). PAPUA: Mt. Dickson, Goilala Subdist., Hartley TGH 12958 ♀ 11,500 ft. (L). Mt. Albert Edward, Brass 4284 ♀ 3,680 m. (A, NY-isotypes), 4284A j (A, NY), 4347 j (NY), 4348 s 3,680 m. (A, NY).

ILLUSTRATION. WASSCHER, J., Blumea 4: t. 4, fig. 8. 1941, as *Podocarpus compacta*.

The particularly large seed completely free of the involucre leaves and the small bifacially flattened not widely spreading leaves distinguish *Dacrycarpus compactus* from other species. *D. expansus*, with rather similar, though spreading leaves, has much smaller seeds and more lanceolate involucre leaves. The wild tree of *D. compactus* is a very striking plant, often rising above the other shrubs near the tree line and standing out with a dark green color. The short juvenile leaves are the most primitive in the genus and apparently only in this species are the juvenile leaves never distichous.

ADDITIONAL SPECIES:

***Dacrycarpus dacrydioides* (Rich.) de Laubenfels, comb. nov.**

Podocarpus dacrydioides Rich. Essai d'une Flore de la Nouvelle Zéland, 358. t. 39. 1832. Type: *D'Urville* in 1827 (not seen).

Podocarpus thujoides R. Br. ex Mirb. Mém. Mus. Hist. Nat. Paris 13: 75. 1825 (*nomen*).

Dacrydium excelsum Cunn. Ann. Nat. Hist. 1: 213. 1838 (*nomen illeg.*, based on *Podocarpus dacrydioides*).

Nageia excelsa (Cunn.) Kuntze, Rev. Gen. Pl. 800. 1891.

***Acmopyle* Pilger, Pflanzenreich IV. 5 (Heft 18): 117. 1903. Type species: *Acmopyle pancheri* (Brongn. & Gris) Pilger.**

Small trees; foliage leaves linear, bilaterally flattened, distichous, with more stomata on the underside, edges sometimes revolute; leaves on non-foliage branches (both fertile shoots and branches of the second order) scale-like, triangular and bifacially flattened; pollen cones terminal and lateral together; seed cones on short branches which are lateral or terminal or grouped together, becoming enlarged and warty as a receptacle with a single subterminal seed; the ovule at first inverted and partially covered by the epimatium, eventually becoming nearly erect, fused with the epimatium, and fleshy.

This genus is characterized by the unique combination of the seed fused with the epimatium (fertile scale), together with an inverted ovule which becomes gradually nearly erect as it matures. The seeds of other genera of Podocarpaceae which are fused with the fertile scale do not become erect. *Acmopyle* shares bilaterally flattened and distichous leaves with *Falcatifolium* and juvenile forms of *Dacrycarpus*. With the latter it also shares a warty receptacle. Two species are known, differing in the character of seed and receptacle as well as in size of the pollen cone and details of leaf-form. Both are island endemics.

29. ***Acmopyle pancheri* (Brongn. & Gris) Pilger, Pflanzenreich IV. 5 (Heft 18): 117. 1903.**

Dacrydium pancheri Brongn. & Gris, Bull. Soc. Bot. France 16: 330. 1869. Type: *Pancher* in 1869, New Caledonia, Mount Mou.

Nageia pancheri (Brongn. & Gris) Kuntze, Rev. Gen. Pl. 800. 1891.

Podocarpus pectinatus Masters, Gard. Chron. III. 9: 113. 1892. Type: *Hort. Sander s.n.*, of New Caledonian origin.

Acmopyle alba Buchholz, Bull. Mus. Hist. Nat. Paris II. 21: 281. 1949. Type: *Buchholz 1704*, New Caledonia, Bois de Mois de Mai.

Tree from 5 to 25 m. high; bark hard and smooth, weathering to a gray color, brown to tan and fibrous within, with scales breaking off on older trees; foliage leaves bilaterally flattened and decurrent, distichous, linear and spreading 60° to 75° from the branch, tapering somewhat towards the apex which is turned slightly in the direction of the shoot apex, or slightly falcate, at first with two glaucous bands on each surface associated with the stomatiferous areas but with further development this condition suppressed on the upper surface but the white bands remaining prominent below, the midrib marked by a faint line on the upper surface and more pronounced below, leaves shorter at the beginning and end of a sequence of growth with the leafy shoots never producing a second cycle of leaves but commonly continued into fertile shoots; shade leaves spread out into a flat and almost solid plane, except for the smaller leaves at either end of the branch, 16–21 mm. long and 2.8–3.0 mm. wide, slightly revolute on the margins; leaves exposed to the sun less regularly placed and more noticeably keeled, often overlapping and weakly spread into a plane, 10–15 mm. long and 1.8–2.2 mm. wide, with intermediate forms sometimes found; non-foliage leaves scale-like, triangular, bifacially flattened, keeled on the back, less than 2 mm. long, on main branches bearing foliage shoots broadly decurrent and dispersed, on fertile branches (and occasionally at the base of a leafy shoot) more or less crowded; pollen cones terminal or often a pair (one of which is lateral) produced at the apex of a leafy shoot or on a scaly shoot which may itself be terminal or lateral either at the apex of a leafy shoot or a main branch bearing leafy shoots (on vigorous trees all of these together), subtended by a few small scales, 10–20 mm. long by 2–3 mm. in diam. (fide Hooker, 1902, to 35 mm. by 4 mm.), the microsporophylls small and triangular; seed cones terminal or lateral at the apex of a leafy shoot, or on a main shoot, or terminal or lateral on a scaly shoot which may be either terminal on a leafy shoot, or lateral on a main shoot (on vigorous trees a combination of these); the seed cone subtended by a peduncle 9–22 mm. long, densely covered by small overlapping scales and slightly enlarged toward the cone to a diameter of about 2 mm.; the cone formed by a fleshy warty receptacle 8–18 mm. long involving about 4 to 8 bracts whose free tips each surmount a bulge; one ovule inverted and protruding from the enveloping epimatium in the axil of a sub-apical bract, becoming almost erect and fleshy, the epimatium completely fused to the mature ovule and apparently attached for about half its length (marked by a roughened area on the seed and a characteristic ridge on the dried fruit); seed globular, 10–11 mm. in diameter, thick and hard.

DISTRIBUTION. Scattered in moist rainforest over serpentine rocks in

most of New Caledonia from near sea level to at least 1,200 meters. Growing as a canopy tree in drier areas and sometimes found in the understory within the mossy forest where it is fully fertile.

New Caledonia. Upper Diahot, Tendé Forest, *McKee* 17540 j 500 m. (P). Mt. Colnett, *Hürlimann* 1964 ♀ 1,200 m. (P, z). Mt. Paéoua, *McKee* 17057 s 900–1,100 m. (P), *Bernardi* 10151 ♀ 900–950 m. (P, z). Mt. Boulinda, *Veillon* 136 ♂ 1,200 m. (P), *Schmid* 137 s (ORSTOM). Crest W. of Col de Rousettes, *de Laubenfels* P429 s 700 m. (A, RSA). Me Arembou, *Bernier* 1007 s (K, P). Mt. Koun-gouhaou N., *McKee* 17954 ♀ 1,000–1,100 m. (P). Mt. Mou, *Pancher* (1869) ♀ 1,200 m. (P-holotype of *Dacrydium pancheri*), *Balansa* 2862 ♀ (BM, K, NY, P), *Compton* 485 ♀ (BM), *Franc* 170 ♀ (A, BM, K, NY, P, z), *Viot* 10 s (A, P), *Le Rat* 697 s (P), 980 ♀ (K, P), 2594 s (A, P), *Bernier* 278 ♀ (P), 1309 ♀ (P), *Buchholz* 1451 ♀ (ILL, K, P), 1587 ♀ (ILL, K, P), 1587S j (ILL, P), 1593S j (ILL, P), 1790 ♂ (ILL, K, P), *McMillan* 5013 ♀ (P), 5014 s (P), *de Laubenfels* P130 ♀, ♂ 1,140 m. (SBT), P355 ♀ (A, K, RSA), P356 ♂ (A, RSA), *Brousmiche s.n.* s (P), *Thorne* 28704 s (P), *Baumann-Bodenheim & Guillaumin* 11260 s (P, z), *Baumann-Bodenheim* 15632 s (P, z), 15633 ♀ (P, z), *McKee* 3517 ♀ 1,100 m. (A, K, P). Mt. Ouin, *McKee* 9795 s (K, P). Col de Mt. Dzumac, *McKee* 9773 s (K, P), 9774 j (K, P), 12922 ♂ (P), *de Laubenfels* P447 ♀ 900 m. (A, RSA), *Baumann-Bodenheim & Guillaumin* 12714 s (P, z), *Blanchon* 930 s (P). Mt. Koghis, *Pancher s.n.* ♀ 800 m. (P), *Alleizette* 142 ♀ (P), *Brousmiche* 9 ♀ (with *Prumnopitys ferruginoides*), *Hürlimann* 1657 s 1,050 m. (P, z). Mt. des Sources, *Hürlimann* 911 s (P, z). Mois de Mai, *Bernier* 276 s (P), 277 s (P), 279 s (P), 280 ♂ (P), 281 s (P), 321 j (P), *Buchholz* 1354 s (ILL, P), 1388 s 200–250 m. (ILL, P), 1388A j (ILL), 1388M ♂ (P), 1698 s (ILL, P), 1698L (shade) s (P), 1704 ♀ (ILL-holotype of *Acmopyle alba*; K, P-isotypes), *McKee* 3454 s 200 m. (A, K, P), *Baumann-Bodenheim* 13964 s (P, z), 14258 ♂ (P, z), 14263 ♀ (P, z), 14988 s (P, z), 14992 s (P, z), 15096 ♂ (P, z), 15097 ♀ (P, z), 15098 s (P), 15130 s (P, z), 15208 s (P, z), 15213 s (z). Slope N. of R. Bleue, *de Laubenfels* P136 s 700 m. (SBT), P382 ♀ 250 m. (A, RSA), P383 ♂ (A, K, RSA, SBT), P383A (shade) s (A, RSA), P446.5 ♀ 770 m. (A, RSA), *Baumann-Bodenheim & Guillaumin* 10929 s (P, z), *Baumann-Bodenheim* 15043 j (z), 15055 s (P, z), *McKee* 12653 s 200 m. (P). Bois Electrique, *Foster* 206 ♀ (P), *de Laubenfels* P377 ♀ 240 m. (A, RSA), P378 s (A, RSA), *Hürlimann* 3411 s 220 m. (z). Without loc., *Mueller* 44 s (ILL, P). Cult., *Hort. Sander s.n.* s (K-holotype of *Podocarpus pectinatus*).

ILLUSTRATIONS. HOOKER, J. D., *Bot. Mag. t.* 7854. 1902, as *Podocarpus pectinata*; PILGER, R., *Pflanzenreich* IV. 5 (Heft 18): fig. 24. 1903; *Nat. Pflanzenfam.* ed. 2. 13: fig. 128. 1926; BUCHHOLZ, J. T., & N. E. GRAY, *Jour. Arnold Arb.* 28: t. 1B. 1947; SARLIN, P., *Bois et Forêts de la Nouvelle-Calédonie*, t. 22 & 23, as *Acmopyle alba*. 1954.

The difference between shade and sun growth forms suggests that two entities are included under *Acmopyle pancheri* but this difference occurs regularly on single plants. *A. alba* differs from *A. pancheri* in having larger pollen cones (18–20 mm. long by 3 mm. in diam. in *A. alba* and 10–13 mm. long by 2 mm. in diam. in *A. pancheri*). There are absolutely no other differences between these two taxa, while even larger pollen cones are described by Hooker (1902). Because only a few examples of pollen cones are available to show variations in size and because speci-

mens can not be distinguished in the absence of pollen cones, it is felt that *A. alba* should not be separated from *A. pancheri* at this time. In the future it might seem advisable to separate them at the varietal level.

30. ***Acmopyle sahniana*** Buchholz & Gray, Jour. Arnold Arb. 28: 142. 1947. Type: *Gillespie 3273*, Fiji, Mt. Vakarogasiu.

Small and gnarled tree 3–5 m. high; leaves bilaterally flattened, distichous, spreading at an angle of 60° to 80°, linear, slightly tapering and curved in the direction of the branch apex near the blunt tip or falcate, decurrent, 10–19 mm. long and 2.0–3.2 mm. wide (wider according to Buchholz and Gray but not according to their illustrations or to herbarium specimens), glaucous on both surfaces at first but losing the glaucousness on the upper surface, mature leaves with two prominent glaucous and stomatiferous bands on the lower surface, very few stomata on the upper surface, midrib faintly marked on both surfaces, margin slightly revolute, leaves smaller at the beginning and end of a sequence of growth with one sequence often continuing into a subsequent growth unit; non-foliage leaves on main branches scale-like, bifacially flattened, long triangular, 1.5–2.5 mm. long, keeled on the back and broadly decurrent, more crowded at the base of a foliage branch and on the peduncle of the seed cone; pollen cones terminal, 5 mm. long and 2 mm. in diam.; microsporophylls triangular, acute; seed cones lateral or terminal on a foliage branch, with a short (5 mm.) scaly peduncle, the cone formed by a fleshy warty receptacle involving two bracts, the uppermost being fertile with a single inverted ovule partly covered by a broad epimatium; seed becoming nearly erect, rounded and elongated into a conical point, with the epimatium fused along one side, its margin forming a fringe about half-way to the micropyle, mature seed not known.

DISTRIBUTION. Known only from two isolated mountains on either side of Viti Levu in dense low forest 800 to 1,050 meters in elevation, where it is locally common.

Fiji. VITI LEVU: Mt. Vakarogasiu (Namosi), *Gillespie 3273* s 900 m. (A-holotype; K-isotype), *Koroiveibau 14598* ♀ 2,600 ft. (K). Mt. Koroyanitu (Mt. Evans Range), *Smith 4122* ♂ 950–1,050 m. (A, BRI, ILL, K). Without loc., *Horne s.n.* s (K).

ILLUSTRATION. BUCHHOLZ, J. T., & N. E. GRAY, Jour. Arnold Arb. 28: t. IA. 1947.

This rare species is of interest because its only relative, *Acmopyle pancheri*, occurs in New Caledonia, not a common combination.

Decussocarpus de Laubenfels, gen. nov. Type species: *Decussocarpus vitiensis* (Seemann) de Laubenfels.

Nageia Gaertner, De Fruct. et Sem. 191. 1788. Type species: *Nageia japonica*, *nomen illeg.* (description confused).

Folia opposita, decussatim vel spiraliter inserta, lanceolata vel rotun-

data, ad basim contracta, uni- vel multinervata. Strobili masculi solitarii vel fasciculati. Strobili feminei pedunculati; pedunculi cum squamis (vel foliis); semina saepius singula, globosa, inversa, squama fertilia cum ovulo conjuncta.

The new genus *Decussocarpus* is composed of three sections formerly treated as a part of *Podocarpus*. A group of characters unite these three sections while distinguishing them from *Podocarpus*. Ovules are produced subterminally on a scaly shoot not divided into a naked peduncle and a specialized receptacle with elongated bracts as in *Podocarpus*, although in some species a part of the fertile shoot becomes fleshy. The micropylar end of the inverted seed extends distinctly downward (towards the base of the fertile complex) so that the mature seed appears to be attached at an angle on the end of the fertile shoot. As a result the seed displays a projecting curved beak in contrast with all related taxa. Associated with the elongated attachment is the tendency for the fruit to fall with the fertile shoot still attached. In contrast with *Podocarpus*, a cluster of five or more pollen cones may occur in some species on a single shoot.

The leaves of *Decussocarpus* have a number of distinguishing characteristics. Opposite decussate leaves are found throughout the genus with the exception that in the section AFROCARPUS some branches have spirally placed leaves (herbarium specimens therefore may lack this character which, nevertheless, can be readily found on any mature living specimen of § AFROCARPUS). A unique leaf orientation further occurs in all sections of the genus, although it may be absent in a few species of the section DAMMAROIDES. The distichous leaves being amphistomatic, instead of making unequal twists on opposing sides of the branch to bring the axial surface of the leaf upwards at all times, always turn in the same manner with respect to the axis so that on the left side the abaxial surface is uppermost. This can be seen in section AFROCARPUS even on branches without decussate leaves. Unlike *Podocarpus*, the leaves of *Decussocarpus* have no accessory transfusion tissue and unlike *Prumnopitys* they do have a hypoderm. Also unlike *Prumnopitys*, the leaves are not linear, but oval or lanceolate.

Most species of *Decussocarpus* are large trees, some of which are valuable timber trees and others are in demand for decorative planting in the warmer parts of the world. The genus is divided into three sections based on the relative width and venation of the leaves. Section DECUSSOCARPUS has single-veined but relatively wide leaves compared to section AFROCARPUS whose leaves are more than ten times as long as they are wide. Section DAMMAROIDES has broad multiveined leaves.

Section DECUSSOCARPUS.

Podocarpus section *Polypodioopsis* Bertrand, Ann. Sci. Nat. V. 20: 65. 1874.
Type species: *Podocarpus vitiensis* Seemann [*Decussocarpus vitiensis* (Seemann) de Laubenfels].

Trees with opposite decussate leaves which are ovate or lanceolate, sessile, sharply narrowed to a decurrent base, single veined, amphistomatic, and not more than about five times as long as wide; pollen cones sessile, solitary or grouped on a special scaly shoot; seed cones in the form of a scaly or leafy shoot with one or rarely two fertile subterminal bracts; ovule inverted and covered by the seed scale which makes an apical crest over the inverted base of the ovule; seed large, globular, blunt at one end but elongated into a curved beak at the micropylar end (at the base of the fruit) and covered by the fleshy seed scale.

An account of this section is given in Wasscher (1941), who shows some uncertainty about how to treat it. Once its characters were completely known, there was agreement that it is most closely related to section DAMMAROIDES (*Nageia* of most authors). The difference in leaf size and venation, however, made it advisable to separate these two taxa into different sections which have until now been treated as a part of the extensive genus *Podocarpus*. The new genus, *Decussocarpus*, is here being proposed to accommodate the two groups and the more recently named section AFROCARPUS in order to recognize the considerable morphological differences that previously have been merged in the one genus *Podocarpus*. Section DECUSSOCARPUS extends from eastern Indonesia to South America, and fossil specimens of it from Chile were once the basis of reports of *Sequoia* in the Southern Hemisphere (Florin, 1940). There are four species.

KEY TO THE SPECIES OF SECTION DECUSSOCARPUS

1. Non-foliage branches bearing scales.
 2. Scales on non-foliage branches appressed, thin; foliage leaves with a sharp narrow midrib; mature pollen cones elongated. 31. *D. vitiensis*.
 2. Scales on non-foliage branches spreading, thick; mature pollen cone globular (rarely elongated).
 3. Mature foliage leaves with a raised central band narrower than the broad leaf margins; forest tree. 32. *D. comptonii*.
 3. Mature foliage leaves with a broad raised central band broader than adjacent leaf margins; small tree at water's edge. 33. *D. minor*.
1. Both primary and secondary branches bearing leaves. (*D. rospigliosii*).

31. *Decussocarpus vitiensis* (Seemann) de Laubenfels, comb. nov.

Podocarpus vitiensis Seemann, Jour. Bot. 1: 33. t. II. 1863. Type: Seemann 576, Fiji.

Podocarpus filicifolius N. E. Gray (in part), Jour. Arnold Arb. 43: 74. 1962. Type: Kostermans in 1949, Morotai.

Tree to 43 m. high; bark brown to red brown, weathering to blackish or gray, fibrous, fissured and peeling in short vertical strips; foliage branches opposite or alternate on non-foliage branches and subtended by a short 1–2 cm. scaly base, sometimes with both lateral and terminal

foliage branches together on the same base, the foliage branch not normally branching again; foliage leaves distichous and equally twisted at the base, lanceolate with a small blunt tip, a narrow but distinct rib marking the vascular bundle on both surfaces, juvenile leaves up to 40 mm. long by 8 mm. wide, adult leaves 15–25 mm. long and 3–5 mm. wide; non-foliage branches with appressed and thin scale leaves which are broadly decurrent and dispersed, 1–2 mm. long; pollen cones single and terminal or grouped with terminal and lateral cones together, either one to three at the apex of a foliage branch or one to three at the apex plus opposite pairs of groups of one to three along a scaly branch, cylindrical, 10–24 mm. long and 1.8–2.2 mm. in diam., microsporophylls triangular, about 1 mm. long; one or two ovules subterminal on a scaly shoot, 6–10 mm. long (which may be terminal or axillary on leafy or scaly branches and solitary or grouped); ovule inverted with the micropyle lying close to the attachment of the seed complex with the micropyle at the end of an elongated beak that may extend more than 2 mm. below the attachment, the fertile scale completely enveloping the ovule and forming over the young seed an apical crest which sometimes persists on the mature fruit; mature seed globular, pear shaped, 13–16 mm. long including the curved beak, 8–10 mm. in diam., covered by the deep red fleshy scale and usually accompanied when it falls by the fertile shoot on which some of the scales may still persist.

DISTRIBUTION. Scattered and locally common in a discontinuous series of regions from Morotai to the Fiji Islands in rainforests, from near sea level to 1,800 meters. MAP 12.

Moluccas. Morotai, *Kostermans* (1949) j (L⁸-holotype of *Podocarpus filicifolius*; (A, K-isotypes). **New Guinea.** WESTERN HALF: Wissel Lakes, Mt. Barara, *Eyma* 5155 j (L). Wissel Lakes, Motito, *Vink & Schram BW* 8730 j 1,800 m. (L). Barnhard Camp (Idenburg R.), *Brass & Versteegh* 12534 s 1,200 m. (A, L), *Brass* 12787 ♀ 1,200 m. (A, BM, K, L), 12787a j (A, L), 12912 ♀ (L). Cycloop Mts., *Versteegh BW* 913 ♀ 1,100 m. (K, L, LAE), *Van Royen & Sleumer* 6073 s 1,220 m. (K, z). **PAPUA:** Koroba Station, *Pullen* 2840 ♀ 5,300 ft. (LAE). Alola, *Carr* 14160 ♂ 6,000 ft. (A, BM, L, NY). Lala R., *Carr* 15666 ♂ 5,000 ft. (A, BM, L). **New Britain.** Mt. Tangis, Talasea Dist., *Frodin NGF* 26292 j 3,500 ft. (L, LAE), *NGF* 26917 s 2,400 ft. (L). Benim, Kandarian Dist., *Henty & Frodin NGF* 27359 ♂ 1,000 ft. (L, LAE). Fullerborn Harbor (Kandarian), *Hammermaster & Sayers NGF* 21842 ♂ 100 ft. (L). **Santa Cruz Is.** Vanikoro, *Walker BSIP* 1580 j (L). **Fiji.** VITI LEVU: Nandarivatu, *Degener* 14483 j 750–900 m. (A, K, L, NY, US), 14496 ♀ (A, NY), *Gillespie* 3865 ♀ (K, NY, US), *Gibbs* 674 ♀, ♂ (BM, K), *Vaughn* 3254 j (BM, K), *Mead* 1964 j (K), 1974 ♂ (K), 1982 s (K). Nausori, *Damanu NH15* s (K). Namboutini (Serua), *de Laubenfels* P309 j 1,000 ft. (A, RSA), *Damanu R10* s (K), *R15* s (K), *R32* s (K), *Qoro & Kuruvoli s.n.* (K). Serua, *Bola* 10 s (K), *Damanu NL8* s (K), *NL10* s (K), *NL12* s (K), *G7* s (K), *G20* s (K). Ndakivuna E. of Wainimbuka R., *Smith* 7076 s 100–200 m. (US).

⁸The Leiden specimen is accompanied by an unattached seed of *D. wallichianus*, a species which was also collected in the area by *Kostermans*. *Podocarpus filicifolius* was based on the presumed pairing of the alien seed with the accompanying leaves (*de Laubenfels*, 1967).

Naikorokoro, *Damanu* KU22 s (K). Galva Forest, *Damanu* 152 ♀ (K). VANUA LEVU: Mt. Kasi (Thakaundrove), *Smith* 1796 s 300–430 m. (A, K, US). Without loc.: *Seemann* 576 j (K-holotype of *Podocarpus vitiensis*; A, BM-isotypes), *Horne* 531 s (K), *Tothill* 844 s (K), 845 s (K), *Graff* 33 s (K).

ILLUSTRATIONS. SEEMANN, B., *Jour. Bot.* 1: t. II. 1863; Fl. Vitiensis, t. 78. 1868, as *Podocarpus vitiensis*.

While in most ways typical of the genus of which *Decussocarpus vitiensis* is the type species, the dimorphic foliage, shared by two other species in section *Decussocarpus* is rather unusual, found elsewhere in the family only in *Dacrycarpus* and *Acmopyle*. The compound clustering of the pollen cones is also unusual occurring sporadically among other genera as *Prumnopitys ladei* and *Acmopyle pancheri*, as well as in such genera as *Taxodium* and *Metasequoia* in the Taxodiaceae. The narrow midrib and the not coarse scales and foliage leaves serve to differentiate sterile specimens of *D. vitiensis* from other closely related species. It is of interest to note that *D. vitiensis* broadly overlaps *D. wallichianus* in its distribution; the latter extends throughout New Guinea as well as further west.

32. *Decussocarpus comptonii* (Buchholz) de Laubenfels, comb. nov.

Podocarpus comptonii Buchholz, *Bull. Mus. Hist. Nat. Paris.* II. 21: 284. 1949.

Type: *Buchholz* 1684, New Caledonia, Mt. Mou.

Tree to at least 30 m. high; bark tan to gray-brown, weathering to gray or dark gray, fibrous, becoming very rough and fissured on older trees, breaking off in short vertical strips or rough fragments; foliage branches opposite or alternate on non-foliage branches or one to several at the apex of an older foliage branch, subtended by one or two pairs of spreading scales; foliage leaves on young plants distichous and equally twisted at the base, lanceolate with a blunt tip, the midrib marked below by a sharp narrow ridge and above by a slight groove, up to 30 mm. long by 6 mm. wide; adult leaves becoming not distichous but still equally turned, coriaceous, the midrib marked by a raised strip narrower than the leaf margins, the edges of the strip when drying appearing as two parallel ridges on both leaf surfaces, ovate-lanceolate, 6–15 mm. long by 2.5–4 mm. wide; non-foliage branches with dispersed spreading scales which are coriaceous, rounded, 1–2 mm. long on young plants and up to 4 mm. long as reduced leaves on fertile specimens; pollen cones single in the axils of foliage leaves, or from one to five or more at the apex of a foliage branch, or in terminal or lateral groups on non-foliage branches (not in compound groups), ovate, 4–6 mm. long (rarely to 12 mm.) and 2.5–3 mm. in diam., microsporophylls short triangular with large spreading edges to the open spore sacs; seed complex terminal on foliage branches or on lateral scaly branches and involving 2–3 decussate pairs of spreading scales or bracts followed by two unequal bracts one of which is fertile, or rarely both are fertile and equal; micropyle of the inverted ovule at the

end of an elongated beak extending about 2 mm. below the spreading fertile bract, the fertile scale completely enveloping the ovule and forming an apical crest which sometimes persists on the mature fruit; mature seed globular, pear shaped, about 20 mm. long including the curved beak and 13–15 mm. in diameter, covered by the glaucous fleshy scale some 2–3 mm. thick which ripens dark red and dries over the seed (if not eaten by some bird), the surface of the seed with low scallops and ridges.

DISTRIBUTION. In rainforests throughout New Caledonia mostly from 750 to 1,450 meters, but also lower where lower rainforests occur. Probably the most common conifer in New Caledonia but always scattered in the forest.

New Caledonia. Ignambi, *Compton* 1524 s (BM), 1587 ♀ (BM), *Foster* 160 j (P), *Hürlimann* 1832 j 1,170 m. (P, z), 1842 ♂ 1,250 m. (P, z), *Däniker* 2902a s (z), *Bernardi* 10347 s 1,100–1,200 m. (P, z). Mt. Colnett, *Hürlimann* 1966 j (P, z). Mt. Panié, *McKee* 15594 ♀ 1,000–1,400 m. (P), 15639 j 800 m. (P). Mt. Tchingou, *Hürlimann* 1220 j 1,250 m. (P, z). Mt. Paéoua, *McKee* 17032 j 900–1,100 m. (P), 17056 ♀ (P), *Bernardi* 10131 s (P, z), 10149 s 900 m. (P, z). Mt. Boulinda, *McKee* 17354 j 1,150–1,300 m. (P), 17357 ♂ (P), *Veillon* 120 j 1,100 m. (P). Mt. Me Maoya, *McKee* 13037 s 1,350 m. (P), 13492 j 1,400–1,450 m. (P). Ridge W. of Col des Roussettes (Me Maoya), *McKee* 9886 ♀ 800–900 m. (K, P). Bourail, below Téné, *Balansa* 1381 ♀ (K, P). Mt. Nekandi (Thio), *McKee* 17908 j 1,200 m. (P). Dent de St. Vincent, *LeRat* 11 j (P). Mt. Humboldt, *Schlechter* 15331 ♂ 1,400 m. (BM, K, P, z), 15332 ♀ (P), *Buchholz* 1578 s 1,300 m. (ILL), *Baumann-Bodenheim* 15393 s 1,400 m. (P, z), 15411 s (z). Mt. Mou, *Vieillard* 3264 ♀ (GH, K, P), *Viot* 8 j (A, P), 38 j (A, P), s.n. j (A, P), *White* 2033 ♂ (A, K, P), *Buchholz* 1085 j (ILL, K, P), 1449 ♀ (ILL, K, P), 1449S j (P), 1452 s (ILL, K), 1684 ♀ (ILL-holotype; K-isotype), 1684S j (ILL, P), 1791 ♀ (ILL), *de Laubenfels* P129 ♂ 1,140 m. (SBT), P360 s (A, RSA), P361 j (A, RSA), *Skottsberg* 202 j (P), *Alleizette* 492 ♀ (P), *McMillan* 5015 ♂ (P), *Däniker* 2902 j (P, z), *McKee* 3516 j (A, P), *Baumann-Bodenheim* 5654B s (z), *Baumann-Bodenheim & Guillaumin* 11257 s (P, z), 11261 s (P, z), 11282 s (P, z), 11299 s (P, z), 11301 s (P, z), *Bernardi* 9879 s (P, z), *Blanchon* 341 s (P). Couvelée, *Brousmiche* 697 s (P). Mt. Dzumac, *de Laubenfels* P153 ♀ (SBT), P415 ♀ 760 m. (A, K, RSA), *Baumann-Bodenheim & Guillaumin* 12725 j (P, z), 12727 j 1,000 m. (P, z), *Aubréville & Heine* 229 ♀ (P), *Barets* 8 j (P), *Bernardi* 9520 ♀ 800–900 m. (P). Upper Ouinné Valley, *Bernier* 267 j 750 m. (P), 268 ♀ (P), *Baumann-Bodenheim & Guillaumin* 12815 s 700 m. (z), 12843 s 700 m. (z), 12861 s (z), 12960 s 900 m. (z). Upper Dumbéa Valley, *Hürlimann* 1062 s 730 m. (P, z). Mt. des Sources, *Bernier* 271 j (P), *Buchholz* 1222 j 950 m. (ILL, K, P), *de Laubenfels* P123 ♂ 1,000 m. (SBT), *Hürlimann* 931 j 800 m. (P, z), 1573 j 530 m. (P, z), *Bernardi* 9445 ♀ 600 m. (P, z). Bois de Mois de Mai (Walker's Place), *Bernier* 203 ♀, j (P), 269 j (P), 270 s (P), *Buchholz* 1350 s (ILL, K, P), 1350A j (ILL, K), 1359 j (ILL, K, P), 1359A j (K, P), 1367 s (ILL), 1697 ♀ (ILL, K, P), *Baumann-Bodenheim* 14057 s (P, z), 15178 s (P, z), 15197 s (P, z). Bois Electrique, *Hürlimann* 3173 ♀ (z). Upper R. Bleue, *Baumann-Bodenheim* 15028 s (P, z). Inland from Bay of Pirogues, *White* 2120 j (A). Without loc. *Sarlin* 228 j (P), *Baudouin* 552 j (P).

ILLUSTRATION. SARLIN, P., Bois et Forêts de la Nouvelle-Calédonie, t. 26. 1954, as *Podocarpus comptonii*.

The juvenile form of *Decussocarpus comptonii* has a great deal in common with the adult form of *D. vitiensis* and the ecology of the two is identical. The adult form of *D. comptonii* is in a number of ways different from its juvenile form. The fact that *D. comptonii* is strictly endemic to New Caledonia while *D. vitiensis* extends for several thousand miles and both to the east and to the west of New Caledonia is a clear illustration of the curiously isolated flora of New Caledonia. There are many closely related species of conifers between the two areas mentioned, but none are common to the two.

33. *Decussocarpus minor* (Carrière) de Laubenfels, comb. nov.

Nageia minor Carrière, *Traité Conif.* ed. 2. 641. 1867. Type: *Vieillard 1275*, New Caledonia, Lake Arnaud.

Podocarpus minor (Carrière) Parlatores in DC. *Prodr.* 16(2): 509. 1868.

Podocarpus palustris Buchholz, *Bull. Mus. Hist. Nat. Paris.* II. 21: 284. 1949. Type: *Buchholz 1421*, New Caledonia, Plaine des Lacs.

Small tree or shrub 2–3 m. high; bark tan to dark brown (often stained with iron oxide from flood waters), very rough, fissured, fibrous, slightly scaly, breaking off in short thick vertical strips or ragged fragments; foliage branches opposite or alternate on non-foliage branches or single to grouped at the apex of an older foliage branch, subtended by one or two pairs of spreading scales; juvenile leaves distichous, equally twisted at the base, not crowded, lanceolate, the midrib marked by a broad raised area that may appear as three ridges when dry, up to 39 mm. long by 3–4.5 mm. wide, on young plants smaller, more crowded, not distichous but still equally twisted; mature foliage leaves almost imbricate and crowded but still (in part) with a slight equal turning, coriaceous, the midrib marked by a broad raised area, wider than the not raised margins (the raised area upon drying either irregularly wrinkled or appearing as three ridges), ovate, blunt, 7–20 mm. long by 2.5–5 mm. wide; non-foliage branches with dispersed spreading scales which are thick, rounded, 1.5–2.5 mm. long, smaller on juvenile specimens; pollen cones solitary or clustered up to five or more, terminal and lateral in the axils of spreading scales on a deciduous shoot at the apex of foliage branches, ovate, 4–8 mm. long by 2–2.5 mm. in diam., microsporophylls triangular with an elongated point; seed complex terminal on foliage branches and involving 2–3 decussate pairs of crowded spreading scales or bracts followed by two unequal bracts one of which is fertile (or rarely both fertile and equal); micropyle of the inverted ovule at the end of a blunt beak which extends up to 2 mm. below the fertile bract, the fertile scale completely enveloping the ovule and forming an asymmetrical apical crest which persists on the mature fruit; mature seed globular pear-shaped, about 20 mm. long including the curved beak and 11–12.5 mm. in diam., covered by the glaucous fleshy scale which sometimes becomes deep red when ripe and after drying tends to crack and flake off the seed (which may persist on the tree for some time or break off anywhere from

the base of the fertile bract to the base of the fertile shoot), surface of the seed rough and porous (making it very buoyant).

DISTRIBUTION. Along lake and river banks in shallow water over soils derived from serpentine, in the headwaters of the Yaté River and along small streams closer to the coast in the southernmost part of New Caledonia, at low elevations (up to 200 meters).

New Caledonia. Pirogues R., *White* 2261 ♀ (A, K, P, US). R. Blanche (Mois de Mai), *McMillan* 5120 s 600 ft. (A, K, P), *Baumann-Bodenheim* 13923 s (P, Z). Upper Yaté R. (22 km. station), *Bernier* 204 ♂, j (P), 245 ♀, j (P), 251 s, j (P), *Buchholz* 1347 s (P), 1348 ♀ (ILL, K, P), 1421 ♀ (ILL-holotype of *Podocarpus palustris*; K, P-isotypes), 1705 j (ILL, K, P), *Sarlin* 73 ♀ (P), *de Laubenfels* P112 ♀, ♂, j (SBT), P160 ♀ (SBT), *Foster* 200 ♂ (P). Marais Kiki (Yaté R.), *McKee* 1118 s (A), 1119 ♀ (A, P), *Baumann-Bodenheim* 6370 j (Z), *Hürlimann* 3157 j (Z). Creek Pernod, *Guillaumin* 8339 j (Z), 8345 ♀ (Z), *Blanchon* 1160 ♂ (P). R. des Lacs, bridge, *Thorne* 28565 ♀ (GH, P), *Baumann-Bodenheim & Guillaumin* 6511 ♂ (Z), 6580, j (P, Z), 6766 ♀ (P, Z), *Hürlimann* 3113 s (Z). R. de Lacs (near Madeleine Falls), *Bernier* 125 j (P), 246 s (P), 249 s (P), 250 ♂ (P), *Le Rat* 2587 ♀ (P), *Buchholz* 1474 ♀ (ILL), 1719 ♀ (ILL), 1729 ♀ (ILL, K, P), *Däniker* 228 ♀ (P, Z), 228a ♀ (Z), *de Laubenfels* P340 ♀ (A, RSA), P340A ♂ (A, RSA), *Baumann-Bodenheim & Guillaumin* 11749 s (P, Z), 11811 s (P, Z), *Stauffer* 5807 ♀ (P, Z), *Blanchon* 736 s (P). Plaine des Lacs in general, *Le Rat* 607 ♀ (BM, P), 751 ♀ (P), 1040 ♀ (K, P), 2621 ♀ (P), *McMillan* 5139 ♂ 600 ft. (A, K, P), *Baumann-Bodenheim & Guillaumin* 6582 j (P, Z), 6594 s (P, Z), *Aubréville & Heine* 130 ♂ (P), 170 ♂ (P). Lac en Huit, *de Laubenfels* P115 ♀, ♂ (SBT), *McKee* 3382 ♀ (A, P, US), *Rohrdorf* 178 ♀ (Z), *Bernardi* 9369 ♂ (P, Z). Grand Lac, *Viot* 658 s (A, P). Plaine des Lacs, lake bank, *Franc* 207 s (A, BM, GH, K, P, US, Z). L. Arnaud, *Vieillard* 1275 ♂ (P-holotype of *Nageia minor*). La Chute, *Blanchon* 208 s (P). Prony Bay (B. du Sud), *Vieillard* 1275 (apparently not the same as the previous collection of the same number) ♂ (A, BM, GH, K, NY, P), *Pancher* (1864) ♀ (P), *Balansa* 186 ♀ (P). *Le Rat* 149 ♀ (P). Carenage, *McKee* 2573 s just above the sea (P). R. du Kaoris (Prony), *Bernier* 247 s 30 m. (P). Kue [Koue] Bay, *Cribs* 1493 ♀ (P). Without loc., *Deplanche* 170 s (P), *Raoul s.n.* s (P), *Petit* 138 ♂ (P), *Brousmiche s.n.* s (P), *Baumann-Bodenheim* 6378 s (P).

ILLUSTRATION. SARLIN, P., Bois et Forêts de la Nouvelle-Calédonie, t. 27. 1954, as *Podocarpus palustris*.

The peculiar habit of this species which grows in shallow water with a swollen base to the trunk (somewhat like a bald cypress), immediately sets it apart. In general morphology it strongly resembles *Decussocarpus comptonii*, but close inspection reveals a different leaf morphology and slight differences in the pollen cone and the seed. This general similarity prevented the recognition of *D. comptonii* as a species for many years.

ADDITIONAL SPECIES:

⁴³*Decussocarpus rospigliosii* (Pilger) de Laubenfels, comb. nov.

Podocarpus rospigliosii Pilger, Notizbl. Bot. Gard. Berlin 8: 273. 1923. Type: *Esposito* 556, Peru, Oxapampa (not seen, A photo.).

Section **Dammaroides** (Bennett) de Laubenfels, comb. nov.

Podocarpus section *Dammaroideae* Bennett ex Horsfield, Pl. Jav. Rar. 41. 1838. Type species: *Podocarpus latifolia* Wallich [*Decussocarpus wallichianus* (Presl) de Laubenfels].

Podocarpus section *Nageia* Endlicher, Syn. Conif. 207. 1847. Type species: *Podocarpus nageia* R. Br. [*Decussocarpus nagi* (Thunb.) de Laubenfels].

Leaves opposite decussate or subopposite, multiveined with the veins converging to the apex, obovate to elliptic, acute, distichous, rather large; terminal buds small, bud scales acute; pollen cones linear, solitary or grouped in the axils of leaves; seed cone on a scaly shoot with one or two subterminal bracts fertile; ovule inverted and enveloped by the fleshy fertile scale; seed globular with a slight protrusion at the micropylar end close to the spreading fertile bract but on the opposite side from the fruit attachment.

The multiveined leaves immediately distinguish section DAMMAROIDES from the remainder of the genus but, without fruit, trees of this group are very similar to the genus *Agathis* of the Araucariaceae. These are distinguished by their globular terminal buds quite different from the acute scales of buds in the section DAMMAROIDES. It has been customary for some time to call this section *Nageia*, ignoring Bennett's name apparently because he used an improper ending. Bennett described his section quite adequately and both Pilger (1903) and Wasscher (1941) refer to his name without comment. Gordon (1858) and others treated this section as a genus, *Nageia* Gaertner, a name which if accepted would have priority not only for the genus being proposed here, but also in the genus *Podocarpus* (if the section were to be retained in that genus). Indeed, Kuntze (1891) did substitute *Nageia* for *Podocarpus* but Pilger (1903) pointed out that the original description of *Nageia* confused its characters with those of *Myrica* ("stam. quattuor et styl. duo.") and, therefore, the name must be rejected.

There are five species differing in the presence or absence of a fleshy receptacle, the number and position of the pollen cones, and the orientation and size of the leaves.

KEY TO THE SPECIES OF SECTION DAMMAROIDES

1. Seed with a fleshy receptacle.
 2. Pollen cones grouped on a peduncle; leaves at least 6 cm. long. 34. *D. wallichianus*.
 2. Pollen cones solitary, sessile; leaves usually less than 5 cm. long (rarely to 7.5 cm.). 35. *D. motleyi*.
1. Seed lacking a fleshy receptacle.
 3. Leaves amphistomatic and equally turned, 20–31 cm. long. 36. *D. maximus*.
 3. Leaves hypostomatic and unequally turned, less than 20 cm. long.
 4. Pollen cone cluster sessile; leaves at least 9 cm. long. 37. *D. fleuryi*.

4. Pollen cone cluster on a peduncle; leaves usually less than 6 cm. long (rarely to 9 cm.). 38. *D. nagi*.

34. *Decussocarpus wallichianus* (Presl) de Laubenfels, comb nov.

Podocarpus latifolia Blume, Enum. Pl. Javae 1: 89. 1827, *nomen illegit.*, non (Thunb.) R. Br. Type: *Blume s.n.*, Java, Mt. Salak.

Podocarpus latifolia Wallich, Pl. As. Rar. 26. 1830, *nomen illegit.* Type: *Wallich 6050*, India, Mt. Silet.

Podocarpus wallichianus Presl, Bot. Bemerk. 110. 1844, based on *Podocarpus latifolia* Wall., which is a later homonym.

Podocarpus blumei Endlicher, Syn. Conif. 208. 1847, based on *Podocarpus latifolia* Blume.

Podocarpus agathifolia Blume, Rumphia 3: 217. 1849, based on *Podocarpus latifolia* Blume.

Nageia blumei (Endl.) Gordon, Pinetum 135. 1858.

Nageia latifolia (Wall.) Gordon, *ibid.* 138.

Nageia wallichiana (Presl) Kuntze, Rev. Gen. Pl. 800. 1891.

Podocarpus latifolia Blume forma *ternatis* De Boer, Conif. Archip. Ind. 14. 1866. Type: *Teysmann s.n.*, Moluccas, Ternate.

Tree up to 48 m. high; bark smooth, peeling in large, thin, very irregular plates, tan to brown within, weathering to dark brown or gray and developing scattered large lenticels and irregular longitudinal markings; leaves decussate, distichous, amphistomatic, equally turned so that the lower surface is exposed on the left and the upper surface is exposed on the right side of the branch, many parallel vascular veins, elliptic, acute to acuminate, sometimes abruptly narrowed to the short (5–10 mm.) petiole, mostly 9–14 cm. long by 3–5 cm. wide but sometimes smaller to 6 cm. long and 2 cm. wide or (particularly for juvenile and shade leaves) up to 23 cm. long and 6.8 cm. wide, the extreme sizes (both smaller and larger) mixed with more usual sizes on the same tree (both extreme width and extreme length not usually together, the ratio of length to width varying from 2 to 6, so that the narrowest leaves are not usually the shortest while the longest are not usually the widest); terminal buds often 2–3 mm. beyond the last pair of leaf bases (lateral buds sessile), abruptly but slightly wider than the stem and then tapering, bud scales acute-acuminate and erect; pollen cones 1–7 on an axillary scaly peduncle 2–10 mm. long with one cone terminal and the remainder in decussate pairs, cylindrical, 8–18 mm. long by 3–4 mm. in diam., microsporophylls lanceolate, 2–3 mm. long; seed cone on an axillary scaly peduncle, 8–20 mm. or more long, the lanceolate scales deciduous as on the pollen cone peduncle; receptacle enlarged and becoming blackish and very fleshy upon maturing, 7–18 mm. long, composed of 4 to 7 sterile bracts, the curled ends of which protrude from the receptacle, and 1 or 2 subterminal fertile bracts with inverted ovules; seed smooth, globular with a small beak next to the point of attachment, completely covered by the thin fertile scale which accompanies the ripe seed, 15–18 mm. in diam.

DISTRIBUTION. In rainforests from eastern India to Normanby Island

east of New Guinea, often as a common forest element at low elevation and extending as high as 1,575 meters (one collection at 2,100 meters).
MAP 13.

India. Mt. Silet, *Wallich* 6050 ♂ (A-isotype of *Podocarpus latifolia* Wallich). E. Bengal, *Griffith* 3005 ♂ (GH, P). Khasia, *Hooker & Thompson* s.n. s 3,000 ft. (A, L), *Apan* 191 ♀, ♂ (GH). Assam, *King* s.n. ♂ (A, L, US). **Thailand.** Tenasserim, *Falconer* s.n. s (L). Kao Luang, N. Stritamurat, *Kerr* 15445 s 600 m. (K). Tamtieng, Ranaung, *Kerr* 11770 ♀ 200 m. (K). Kapor, Ranaung, *Kerr* 16703 ♀ 50 m. (K). Kumpuam, Ranaung, *Kerr* 16864 ♀ 50 m. (K). Kuabun, Ranaung, *Kerr* 16351 s 50 m. (K). Lem Dan, Kaw Chang, *Rabil* 19 s (K). Klaung Non Si, Kaw Chang, *Kerr* 9324 s 10 m. (K). Kao Kuap, Kuat, *Kerr* 17714 s 500 m. (K). Kao Ri Yai, Kanburi, *Kerr* 10400 s 1,400–1,500 m. (K). Baw Rai Kinat, *Kerr* 9509 s 300 m. (K). Adang, Sulut, *Kerr* 14132 s 500 m (K). Khas Yai, 105 km. E. of Saraburi, *King* 555A ♀ 780 m. (L). **Laos.** Pak Munung, Wengchau, *Kerr* 21215 ♂ 1,400 m. (K, P). **Cambodia.** Phnom San Kas, *Müller* 499 s (P). Elephant Mts., *Poilane* 23216 s 200 m. (P). Kre-dek, *Poilane* 14664 s 600 m. (P). **Cochin China.** Phu Quoc I., *Pierre* 5529 s (A, NY, P), 5530 ♀ (A, P). **Annam.** Vinh, Linhcam, *Chevalier* 38234 s (P); Ke Bon, *Chevalier* 38127 s (P). Quang-nam (S. of Da Nang), *Poilane* 31558 s 500 m. (P). Massif Ngok Guga near Dakto, *Poilane* 35675 s 1,000 m. (P). Massif du Brian near Djiring, *Poilane* 24234 s (P), 24314 s 1,500 m. (P). Phan Rang (Can-Wa), *Poilane* 5963 ♀ 900 m. (A, P). W. of Ca Na, *Evrard* 2422 s 1,200 m. (A, NY, P). **Malaya.** Jerai Reserve, Kedah, (*Mal.*) 17848 s (K). Kledang Saiang Reserve, Perak, *Mead* 12828 ♀ (K), *Noakes* 20133 ♀ (K), 22147 s (K). Kinta, Perak, *Low* 64 ♀ (K). Perak, *Scortechini* s.n. j (A). Kebal Ayam, Kurantan, Pahang, *Loh* 15065 s (K). B. Soga, Johore, *Ridley* 11223 s (K). Labis, *Sinclair* 38991 s (L). Johore, G. Pulau, *Sinclair* 10578 j (K, L, NY). **Sumatra.** Mt. Sibajak, E. Coast, *Lörzing* 7336 ♂ 1,200 m. (L), 11664 s 400–425 m. (L), 15531 ♂ 1,350 m. (L). Karo Plateau, Mt. Siosar, *Lörzing* 8628 s 1,575 m. (L), 15657 s 1,525 m. (L). Bandar Betsy, Simelungun, *NIFS* bbE1352 j 50 m. (L). E. Coast near Kisaran, *Krukoff* 238 j (A, NY, US). E. Coast, Asahan, *Yates* 2554 ♀ (A, NY). *Boeea* 6255 j (A, L), *Bartlett* 8108 s (US). Tapanuli, Sibolga, *NIFS* bb1357 j 5 m. (L). Tapanuli, Angkola, *NIFS* bb31536 s 600 m. (L). Benkulen, Redjang, *Endert* bbE1084 s 800 m. (L), *Renwarin* bb2450 ♀ (L), *NIFS* bb8842 s 900 m. (L). Palembang, Banjuasin, *NIFS* bbE1106 s 15 m. (L). Palembang, Pasemah land, *NIFS* TB200 s 1,200 m. (L). Palembang, G. Pakiwang (Ranau L.), *Van Steenis* 3754 s 1575 m. (L). **Java.** G. Lajung, *Koorders* 1261 s 150–250 m. (L). G. Salak (Batavia), *Anon.* (1845) s (L), *Koorders* 24181 s 1,000 m. (L). Preanger, Parakan Salak, *Koorders* 39402 s (K, L), 39403 s 1,000 m. (A), 39404 s (L), 39406 s 1,100 m. (A), 39407 s 1,350 m. (A), 39409 s 1,000 m. (L), 39413 s 1,000 m. (L), 39415 s (A). G. Megamendong, *Junghuhn* s.n. s (L). G. Pangarango, *Junghuhn* s.n. ♀ 3,000 ft. (L). G. Gedeh, *Anon.* 204 s (L), *Hasskarl* 346 ♂ (L). Takokak, *Koorders* 1262 s (L), 1264 s (L), 11909 s (L), 39592 s 1,200 m. (A), 39596 s (A, L). Preanger, Tjipatudja, *Backer* 8866 s 450 m. (L). Without loc., *Blume* s.n. ♀ (L-lectotype, *Podocarpus latifolia* Blume), s.n. s (L), *Hasskarl* s.n. j (L), *Junghuhn* s.n. s (L), *Miquel* s.n. ♂ (L). **Karimata.** Sung Tajan, *Teysmann* 11598 s (L). **Billiton.** *Riedel* (1876) ♀ (FI). **Sarawak.** Lundu, G. Gading, *Anderson* 15391 ♀ 2,600 ft. (K, L). B. Mersing, in from Tatau, Luang S22176 ♀ 900 m. (K). Bintulu, Merurong Plateau, *Brunig* S9999 s 820 m. (L). Lawas, *Brunig* S12083 s 1,000 m. (L). Mt. Majan, *Clemens* 21822 j (NY). **North Borneo.** Penampang, *Leaño-Castro* 5989 s, 5,000 ft. (K, L). Mt.

Kinabalu, *Clemens s.n.* j 7,000 ft. (NY), *Chew & Corner RSNB* 4878 ♀ 5,000 ft. (K). Elopura, Sandakan, *Keith A7* s 10 ft. (K). Gompa, Kudat, *Balajadia* 4055 s sea level (K). Tawau, *Ampon A1652* ♀ (K, US), *Martyn SAN* 18453 ♀ 50 ft. (K, L, NY), *Meijer SAN* 19547 s 30 ft. (L). Without loc. *Wood* 1244 j (A, K), *s.n.* s (US), *Burbridge s.n.* j (K). **Borneo.** Tidung's Land (SE. Borneo), *NIFS bb18217* s 4 m. (A, L). G. Beratus (Balikpapan), *Kostermans* 7464 s 900 m. (A, L), 7486 ♀ 900–950 m. (A, K, L). Samarinda, *Kostermans* (1956) ♂ low (L). Mahakam, *Amdjah* 51 j (L). Mt. Palimasen (Cent. Kutei), *Kostermans* (1954) ♂ 900 m. (K, L). **Philippines.** Cagayan, *Curran* 16738 ♀ (US), 17200 ♀ (NY, US). Mt. Sulu (Apayao Subprov.), *Fenix* 28348 ♀ (A, NY, US). Mt. Moises (Isabella), *Ramos & Edaño* 46333 ♀ (A, NY). Baguio, *Williams* 1035 s (K, NY, US). Lamao R., Mt. Mariveles (Bataan), *Williams* 399 s 2,200 ft. (NY, US), 624 ♀ 3,000 ft. (NY), 752 ♀ 2,000 ft. (NY), 753 ♀ 1,800 ft. (A, K, NY, US), *Barnes* 147 ♀ (K, NY, US), 194 ♀ (K, NY, US), *Copeland* 244 ♀ (K, NY, US), *Whitford* 1353 ♀ (K, NY, US), *Curran* 17616 s (L). Mt. Giting-Giting, Sibuyan I., *Elmer* 12360 ♀ (A, K, L, NY, US). **Celebes.** Usu (Malili), *NIFS Cel/III-80* s (A, K, L), *Cel/III-143* s 10 m. (A, L), *Cel/III-146* s 25 m. (K). Tebetano (Malili), *NIFS bb24489* j 450 m. (A, L). Tawingana (Malili), *NIFS bb25541* s 120 m. (L). Tamborano (Malili), *NIFS bb9696* s 600 m. (L). Gorontalo Buladu (Manado), *NIFS bb15602* s 400 m. (L). Poso, Majoa (Manado), *NIFS bb31500* s 700 m. (L). Manado, Kolonodale, Bakomtefe, *NIFS bb31506* s 100 m. (A, L). Lapo Lapo, SE. of Kandari, *Becari* (1874) s (FI). **Moluccas.** Obi, *Ahasrip* 118 s (K, L, NY). Ternate, *Teysmann s.n.* j (L-holotype of forma *ternatis*). Morotai, *Kostermans* 1660 s 50 m. (A, L). W. Ceram, *NIFS bb19647* s (L). **New Guinea.** VOGELKOP: Warsamson Valley (E. of Sorong), *Moll BW* 11652 s 30 m. (L). Kebar Valley, Tobie, *Schram BW* 7951 s 740 m. (L), *Smit BW* 2314 s 650 m. (L), *Sijde BW* 5579 s 750 m. (L). Nerto, Kebar Valley, *Mangold BW* 2350 ♀ 750 m. (L). Kebar Valley, *Van Royen* 5058 ♀ 550–700 m. (K, L). Sidai (W. of Manokwari), *Schram BW* 1785 s (L), *BW* 6174 s 5 m. (L), *Koster BW* 6705 s (L), *BW* 6760 ♀ 10 m. (K, L), *BW* 6922 s 10 m. (L), *BW* 6977 s 5–10 m. (L). Manokwari, *Menusefer BW* 8180 ♀ 140 m. (L). Baru (Teminabuan), *Hallewas BW* 944 s 10 m. (L). Beriat (S. of Teminabuan), *Schram BW* 6021 ♀ 10 m. (L). SERUI: Biak, *NIFS bb30717* s 50 m. (A, L), *bb30779* s 80 m. (A, L), *bb30813* ♀ 50 m. (A, L), *bb30887* s 50 m. (L), *Moll BW* 9574 s 35 m. (L), *BW* 9589 s 35 m. (L). Mios Num. I., *NIFS bb30939* s 200 m. (A, L), *bb30947* s 200 m. (A, L), *bb30961* s 200 m. (A, L). Japen, Sumberaba, *Koster BW* 11121 s 8 m. (L). Japen, Aisao, *Schram BW* 10596 s 200 m. (L). Japen, *NIFS bb30260* s 300 m. (L). WEST: Armina (Babo), *Moll BW* 12968 s (L). Agondo (Babo), *Lundquist bb32983* (264) s 20 m. (K, L). Esania, Borowai (Fak Fak), *Stefels BW* 3147 s 20 m. (L). Tiwara, Arguni Bay, *Telussa BW* 5158 s (L). Tairi, Kaimana, *Loupulua BW* 5140 ♀ 230 m. (L). Najaja (Uta), *Lundquist bb32845* (126) s 3 m. (K, L). Djera, near Uta, *Aet* 271 s (L). CENTER: Barnhard Camp, *Brass & Versteegh* 13175 ♀ 850 m. (A), 13555 ♀ 150 m. (A, L). Cycloop Mts., *Koster BW* 4301 s 500 m. (L). Muju Subdiv. (near Papua, S. edge of mts.), *Kalkman BW* 8502 ♀ 120 m. (L). TERR. NEW GUINEA: Yambi Yambi, Sepik, *Womersley NGF* 3704 s (K). Sepik, *Ledermann* 9027 s (K). Mt. Salall, Passir (Madang), *Zollinger* 3025 s (A, FI). Oriemburg, *Clemens* 1231 s 2,500 ft. (A, L, z). Sattleberg, *Clemens* 2172 s 2,000 ft. (A, z). Near Lae, *Womersley NGF* 17621 ♀ 500 ft. (K, L). Gabensis (Lae), *NGF W41* j (A). PAPUA: Fly R., *D'Albertis* (1877) s (FI). L. Daviumbu (Middle Fly), *Brass* 7909 s (A, L). Sibium Range, *Pullen* 5932 s 2,300 ft. (L). Oriomo R., *Hart* 5005 ♀ (A, K, L), *Brass* 5878 s (A, K, L, NY, US), 5880 j (A, NY, US), 5906 s 5–10 m. (A, NY), *White & Gray*

NGF 10415 ♀ 70 ft. (K, L). Sogeri, in from Port Moresby, *Forbes* 911 s (L), *Anon.* NGF 4503 j (A, K, L). Ramoi, *Beccari* 365 ♀ (FI). Maipa (Kairuku), *Darbyshire* 971 ♀, j 200 ft. (K, L), *Saunders* 1088 s (L). Dieni, Ononge Road (Cent. Div.), *Brass* 3962 j 500 m. (A, NY). Milne Bay Dist., *Womersley* NGF 19298 ♀ 1,200 ft. (K, L). Normanby I., *Brass* 25824 j 600 m. (A, L).

ILLUSTRATIONS. BLUME, C. L., *Rumphia* 3: t. 173. 1849 (as *Podocarpus agathifolia*); PILGER, R., *Pflanzenreich* IV. 5 (Heft 18): fig. 9A (as *Podocarpus wallichianus*) & fig. 9B (as *Podocarpus blumei*). 1903; *Nat. Pflanzenfam.* ed. 2. 13: fig. 134A (as *Podocarpus wallichianus*) & fig. 134B (as *Podocarpus blumei*). 1926; KOORDERS, S. H., & TH. VALETON, *Atlas der Baumarten von Java* 3: t. 588. 1915 (as *Podocarpus blumei*).

Podocarpus wallichianus and *P. blumei* have generally been treated as distinct species but are here being united under the name *Decussocarpus wallichianus*. Wasscher (1941), who treated *Podocarpus blumei*, analyzed the two taxa and concluded they were probably the same. The differences reported, as thickness of leaf and acuminate leaf tip, are variations that may occur even on a single plant depending on age and exposure. Further, considerable variation in leaf dimensions are frequently found on single herbarium sheets. By comparing the predominant sizes within any region, it appears that this species is, in fact, rather consistent throughout its considerable range.

35. *Decussocarpus motleyi* (Parlatore) de Laubenfels, comb. nov.

Dammara motleyi Parlatore, *Enum. Sem. Hort. Bot. Mus. Florent.* 26. 1862.

Type: *Motley* 1300, Borneo, Bandjarmasin.

Podocarpus beccarii Parlatore in *DC. Prodr.* 16(2): 508. 1868. Type: *Beccari* 2649, Sarawak, near Kuching.

Nageia beccarii (Parlatore) Gordon, *Pinetum* 2: 186. 1875.

Agathis motleyi (Parlatore) Warburg, *Monsunia* 1: 185. 1900.

Podocarpus motleyi (Parlatore) Dümmer, *Jour. Bot.* 52: 240. 1914.

Tree up to 40 m. high; leaves opposite or subopposite, amphistomatic, distichous, coriaceous, elliptical, acute or with a small acuminate tip, narrowed at the base to a short thick petiole 2–3 mm. long, somewhat variable in shape, usually 3–5 cm. long and 15–22 mm. wide but reaching 7.5 cm. long and 28 mm. wide; terminal buds compact, tapering at first, the scales rounded to lanceolate, acute to acuminate, 3–5 mm. long; pollen cones axillary, solitary, sessile, cylindrical, 15–20 mm. long when mature and 5–6 mm. in diameter; microsporophylls lanceolate, keeled, 2 mm. long; seed cone on an axillary scaly peduncle 2–5 mm. long with 3–4 pairs of decussate deciduous scales, receptacle becoming fleshy (on some specimens with nearly fully developed seed there is no enlargement), 8–12 mm. long, composed of 5 to 9 spreading sterile bracts, the single subterminal fertile bract with an inverted ovule covered by the fertile scale; seed smooth, globular, with a small beak at the micropylar end near the point of attachment, 13–16 mm. in diam.

DISTRIBUTION. Mostly in low poorly drained areas but extending to 500 meters elevation in rainforests, from Sumatra and Malaya to the southern part of Borneo. MAP. 14.

Malaya. G. Tebu (Trengganu), *Sinclair & Salleh SFN 40798* s (L). Lumut, Dindings (Perak), *Hadden 16554* ♀ (κ), *Symington 27841* s (κ). Legari Melintang, Dindings, *Strugnell 16568* s (κ). Johore, S. Kayu, Mawai-Temulang Road, Corner 21341 s (κ). Sumatra. Barus (Sibolga), Tapanuli, *NIFS bb29532* s 25 m. (A, L), *bb31596* s 1 m. (A, L). Near Banjunglintjir, Palembang, *NIFS 12T1P13* ♂ 15 m. (L), *12T1P185* ♀ 15 m. (L), *Thorenaar 12T13* s (L), *Grashoff 874* ♂ 20 m. (L). Rawas, Palembang, *Grashoff 1138* ♀ 150 m. (L). Riau Arch., Karimon, *NIFS bb17229* s 150 m. (A, L). Belimbing, *NIFS bb28495* s 6 m. (A, L). Sarawak. Near Kuching, *Beccari 2649* ♀ (FI-holotype of *Podocarpus beccarii*; κ-isotype). G. Perigi (Lundu), *Anderson 13304* ♂ 1,000 ft. (A, κ). Simunjan, *Drahman S0316* s sea level (L). Without loc., *Foxworthy 353* ♀ (κ). Borneo (SE. part). Tidung's Land, S. Lebakis, *NIFS bb18328* s 5 m. (A, L). Bandjarmassing, *Motley 1300* s (κ-isotype of *Dammara motleyi*). Puruk Tjahu, Tahudjan, *NIFS bb21151* ♀ 500 m. (A, L).

ILLUSTRATION. WASSCHER, J., *Blumea* 4: t. 4, fig. 11. 1941, as *Podocarpus motleyi*.

The extremes of leaf sizes in *Decussocarpus motleyi* and *D. wallichianus* approach each other and the latter occurs throughout the range of the former so that the possibility of confusion exists. The pollen cones are diagnostic and the terminal buds lying directly above the last leaf attachment help to differentiate the two. By observing the most common leaf sizes of a tree (or even a specimen), however, the species can be readily separated. The lack of enlargement of the receptacle on some specimens (see *NIFS 12T1P185*) merits further observation.

36. *Decussocarpus maximus* de Laubenfels, sp. nov.

Arbor parva, 4.5 m. alta; folia magna, decussata, coriacea, elliptica, acuminata, basi magis rotundata, in petiolum perbreve angustata, 20–34 cm. longa, 6–9 cm. crassa; gemmae parvae, acuminatae; strobili feminei ramunculum axillarem 12 mm. longum formantes; squamae ramusculi decussatae, 3–4 mm. longae, deciduae; receptaculum nullum; semen globosum, diametro ca. 16–18 mm. Holotypus: *Anderson 3361/7* (L), Sarawak, Sibuh. FIG. 10.

DISTRIBUTION. In low elevation swamp forest of Sarawak and possibly Sumatra.

Sarawak. Sg. Assan, Naman F. R. (Sibu), *Anderson 3361/7* ♀ 12 ft. (L-holotype; κ-isotype). Sumatra. Silo Maradja (Ashan), *Bartlett 6805* s (κ, L, NY, US). Between Djuma Tombak and Taratak, Tanah Djawa (Simelungun), *Bartlett 8226* s (NY, US). Bangka, Sungei liat, *Teysmann s.n.* s (L).

Decussocarpus maximus is unique in the genus in combining a lack of a fleshy receptacle with amphistomatic leaves, although, as mentioned above, some specimens of *D. motleyi* with very small leaves may also

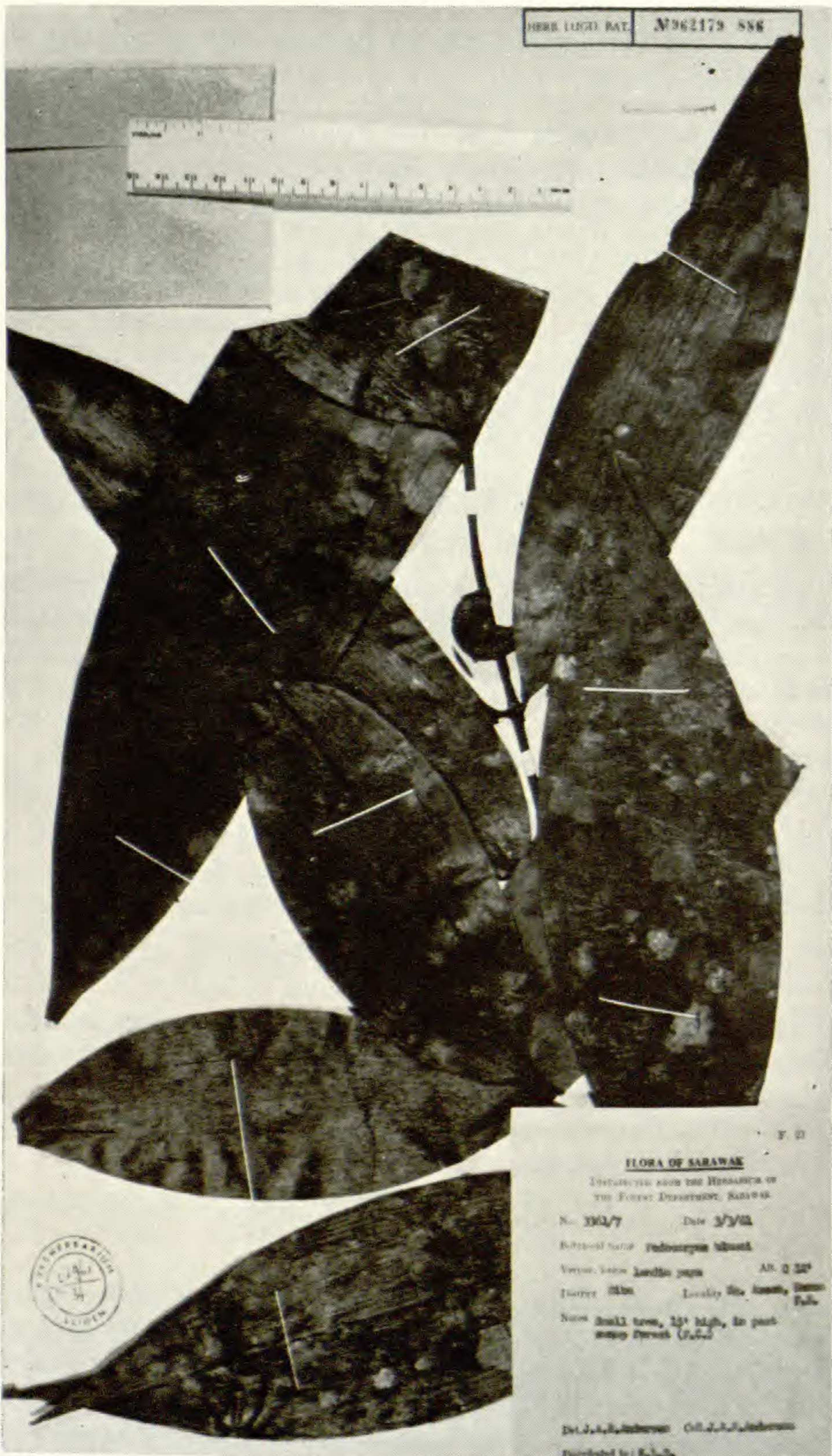


FIGURE 10. *Decussocarpus maximus* de Laubenfels, photograph of the holotype, J. A. R. Anderson 3361/7 (L).

combine these characters. The leaves of *D. maximus* are without question the largest of any conifer, being approached at their lower limits by juvenile leaves of *D. wallichianus* and of various species of *Agathis*. The largest leaves described above belong to a fertile specimen. Aside from leaf size, the leaf form and terminal buds correspond to *D. wallichianus* but the seed is produced on a shoot that is not fleshy. The range of *D. maximus* is included within the range of closely related species and the Sumatra specimens, being sterile, are distinguished by their leaf size only (*Bartlett 6805*: 15–20 by 6.5–9 cm. and blunt, possibly from damage; *Bartlett 8226* and *Teysmann* (Bangka): 20–22 by 7–8 cm.). In having neither hypostomatic leaves nor a fleshy receptacle, *D. maximus* (and perhaps a part of *D. motleyi*) exemplifies best, among the species in section *Dammaroides*, the special characteristics of the genus.

37. *Decussocarpus fleuryi* (Hickel) de Laubenfels, comb. nov.

Podocarpus fleuryi Hickel, Bull. Soc. Dendrol. France 75: 75. 1930. Lectotype: *Fleury 38017*, Tonkin, Phu Tho.⁹

Tree to at least 10 m. high; leaves opposite, decussate, coriaceous, hypostomatic with unequal turning so that the upper surface of the leaf is always uppermost, elliptic, acuminate, narrowed at the base more or less to a petiole, 8–18 cm. long and 3.5–5 cm. wide; terminal bud large, somewhat beyond the nearest leaves, tapering sharply, but scales lanceolate, acute, erect; pollen cones grouped in an axillary sessile cluster of three and subtended by several pairs of overlapping, broad, keeled scales, long cylindrical, about 3.5 cm. long and 4 mm. in diam.; microsporophylls small, triangular, acute; seed cone on an axillary scaly not enlarged peduncle, 15–20 mm. long; ovule inverted in the axil of a subterminal bract; seed globular, 15–18 mm. in diam. FIG. 11.

DISTRIBUTION. In mountain forests from northern Annam to Kwangtung. MAP 14.

Kwangtung. Naam Kwan Shan (Tseng Shing Dist.), *Tsang 20123* ♂ (A, NA, NY, US), 25273 ♀ (A). **Tonkin.** Phu Tho, *Chevalier 38017* ♀ (P-lectotype). Hoa Binh, *Ste. forestier 8408* s (P-syntype). Phu Huo, *Chevalier 37512* s (P). **Annam.** Vinh, Nghe An, *Fleury 30180* s (P-syntype). Near Hue, *Poilane 29808* ♀ 1,300–1,400 m. (ILL, P). Mt. Bana (25 km. from Tourane), *Clemens 4190* s (A, K, NY, P).

The much larger leaves distinguish sterile specimens of *Decussocarpus fleuryi* from *D. nagi*, although both have hypostomatic leaves. Otherwise, the female peduncle of *D. fleuryi* is longer, the pollen cones are longer, and, particularly, the pollen cone cluster is sessile. The general form of the leaf corresponds with that of *D. wallichianus* and even Hickel, in the original description, included a specimen of the latter (*Poilane 5963*) among the specimens he listed. However, the stomatic condition and

⁹ Chevalier is given as the collector for this specimen on the sheet in Paris.



FIGURE 11. *Decussocarpus fleuryi* (Hickel) de Laubenfels, photograph of Tsang 25273 (A).

orientation of the leaves at once distinguish even sterile specimens. The sessile pollen cluster and the lack of a fleshy receptacle also separate these two species.

38. *Decussocarpus nagi* (Thunberg) de Laubenfels, comb. nov.

Myrica nagi Thunb. Fl. Japon. 76. 1784. Type: ex herb Thunb., microfiche no. 23381 (A-GH).

Nageia japonica Gaertner, De Fruct. et Sem. 1: 191. 1788 (in part, *nomen illeg.*, description confused).

Podocarpus nageia R. Br. ex Mirbel, Mem. Mus. Paris 13: 75. 1825 (based on *Nageia japonica*).

Podocarpus cuspidata Endl. Syn. Conif. 207. 1847. Hort.

Nageia cuspidata (Endl.) Gordon, Pinetum 136. 1858.

Nageia ovata Gordon, Pinetum, Suppl. 42. 1862. Type: *Fortune* in 1861, Japan, Yeddo (not seen).

Podocarpus nageia R. Br. var. *rotundifolia* Maxim. Gartenflora 13: 37. 1864 (based on *Nageia ovata* Gordon).

Podocarpus nageia R. Br. var. *angustifolia* Maxim. *ibid.* Hort.

Podocarpus ovata (Gordon) Henk. & Hoch. Syn. Nadelh. 381. 1865.

Dammara veitchii Henk. & Hoch. *ibid.* 216. Hort.

Podocarpus japonica (Gaertner) Nelson, Pinac. 155. 1866, *nomen illeg.*, non Siebold.

Podocarpus caesius Maxim. Mém. Biol. 7: 561. 1870. Hort.

Nageia nagi (Thunb.) Kuntze, Rev. Gen. Pl. 798. 1891.

Podocarpus nagi (Thunb.) Makino, Bot. Mag. Tokyo 17: 113. 1903.

Podocarpus nagi (Thunb.) Makino var. *rotundifolia* (Maxim.) Makino, *ibid.* 114.

Podocarpus nagi (Thunb.) Makino var. *angustifolia* (Maxim.) Makino, *ibid.*

Podocarpus formosensis Dümmer, Gard. Chron. III. 52: 295. 1912. Type: *Schmüser* 1357, Formosa, S. Cape (not seen, photo of type accompanies descript.).

Podocarpus nankoensis Hayata, Ic. Pl. Formos. 7: 39. 1918. Type: *Hayata* in 1916, Formosa, Nanko.

Podocarpus nagi (Thunb.) Makino var. *koshunensis* Kanehira, Trans. Nat. Hist. Soc. Formosa 21: 145. 1931. Syntypes: *Mori* 25075, *Sasaki* 25076, 25077, *Kanehira* 26078, 22239, *Matsuda* 2594 (not seen).

Podocarpus koshunensis (Kanehira) Kanehira, Formosan Trees. Rev. ed. 36. 1936.

Tree to 25 m. high; bark smooth, peeling in thin flakes, dark brown weathering gray; leaves decussate, distichous, hypostomatic, multiveined, elliptic, acuminate, to rounded at the tip, the apex often showing evidence of aborted growth, sometimes abruptly narrowed to a short wide petiole, often glaucous especially on the underside, 4.5–5 cm. long or sometimes longer, 10–20 mm. wide, somewhat variable in size and shape even on individual specimens; terminal bud often 1–2 mm. beyond the last pair of leaves, abruptly wider than the stem and then tapering to an acuminate apex, bud scales long lanceolate; pollen cones 1–5 on an axillary scaly peduncle 3–10 mm. long, subtended by a lanceolate scale up to 6 mm. long, cylindrical, 10–20 mm. long, the longer ones terminal in the cluster,

microsporophylls small, acuminate, widely spreading and not crowded, about 1 mm. long; seed cone on an axillary peduncle with deciduous lanceolate scales, peduncle 5–10 mm. long, not enlarged; one or two seeds developing from inverted ovules (rarely there are 3 ovules) in the axils of subterminal bracts, completely covered by the seed scale, globular and elongated into a hooked beak at the micropylar end, smooth, glaucous, the seed itself 12–13 mm. wide and 15–16 mm. long, the fleshy bluish-black covering at least 2 mm. thick but drying on the seed and wrinkling, the seed often falling with the peduncle attached.

DISTRIBUTION. Scattered from southeastern China and Hainan to southern Japan in forests at low elevation, up to 800 meters in more southerly parts. Because of the high degree of disturbance of forests almost throughout its range and its popularity in cultivation, it is most difficult to distinguish between plants naturalized from cultivated sources and truly native individuals. Probably some of the specimens cited are, in fact, cultivated even where not indicated as such. MAP 15.

China. HAINAN: Pak Shik Ling (Cheng Mai Dist.), *Lei* 745 ♀ (A, L, NY, US). Pak Shek Shan (Lam Ko & Cheng Mai Dists.), *Tsang* 681 (*L.U.* 17430) s (A, L, NY, US). Nodda, Sha Po Ling, *McClure* 8131 ♀ 800 m. (A). Manning, *How* 73876 s 700 ft. (A, P). KWANGSI: Ta Tse Tsuen, Yung Hsien, *Steward & Cheo* 728 ♀ 380 m. (A, NY, P). Sup-man-ta Shan, *Liang* 69401 s (A). Wah Kong (Hing On Dist.), *Chung (Tsoong)* 83667 s (A), KIANGSI: Tung Lei (Kiennan Dist.), *Lau* 3964 ♀ (A, US). FUKIEN: Hinghwa, *Chung* 924 ♀ (A). Yenping, *Chung* 2979 ♀ (A), 3570 s (A), *Dunn* 3523 ♀ (A). CHEKIANG: Pingyang Hsien, *Ho* 1554 ♀ (A). Tsingtien, *Keng* 99 ♀ (A), 20–40 miles W. of Wenchow, *Ching* 1832 ♀ 250–450 m. (A, P, US). Yentang Shan, *Chiao* 14685 s (A, NY, US, z), *Hu* 241 ♀ (A). Without loc., *Chen* 4091 ♀ (A). **Formosa.** SOUTHERN: Koshun (=Hengchun), *Kanehira* 28 s (A), 29 s (A). E. COAST: Hualien, *Kuntz* 084 ♂ (US). Nanwo (Karenko Prov.), *Wilson* 11109 s (A, US). NORTHERN: Nanko, *Hayata* (1916) ♂ (A-isotype of *Podocarpus nankoensis*). Tamsui, Chapa, *Henry* 1446 s (A, NY, US). Kankou (Taipei Co.), *Kao* (1960) ♀ (L). Kangu (Taipei), *Keng s.n.* s (US). Urai (Taihoku Prov. = Taipeh), *Wilson* 10279 s (A, US). Herinki (Taihoku Prov.), *Wilson* 10242 s 660 m. (A, US). Siusuie, *Kanehira* 14 s 2,500 ft. (A). **Ryukyu Islands.** Ishigaki I., Kabira, *Smith* 66 s (US). Okinawa, Mt. Kunchon, *Wilson* 8064 s 0–200 m. (A); Linkin, *Kimura & Hurusawa* 95 s (US); Sonohara, *Tawada & Amano* 6290 s (US). **Japan.** KYUSHU: Kagoshima, *Wilson* 6262 s (A). Near Kumamoto, *Wilson* (1917) ♀ (A). HONDO: Kurashiki (Okayama), *Uno s.n.* ♀ (A). Kasugayama (Nara), *Kume s.n.* ♂ (A). Shizuoka, *Dorsett & Morse* 763 ♂ (US). Between Kamakura & Zushi, *Beattie & Kurihara* 10437 s (US). Toke (Chiba Pref.), *Walker* 5649 ♂ (US). Tamato, *Wilson* (1904) ♂ (A). Yakushima (betw. Ambo & Kasugidani), *Moran* 5351 s 350 m. (US).

ILLUSTRATIONS. PILGER, R., *Pflanzenreich* IV. 5 (Heft 18): fig. 9C–E. 1903; *Nat. Pflanzenfam.* ed. 2. 13: fig. 134C–E. 1926, as *Podocarpus nagi*; DÜMMER, R., *Gard. Chron.* III. 52: t. 132. 1912, as *Podocarpus formosensis*; KANEHIRA, K., *Formosan Trees*, rev. ed. t. 4. 1936, as *Podocarpus koshunensis*.

The large number of specific names which have been applied to *Decussocarpus nagi*, including several horticultural names, result from long acquaintance with it in cultivation, and from its wide distribution. Most of the differences noted for the various units proposed are within the normal variation of a population or even of an individual. The variety *rotundifolia* (equals *Nageia ovata*) of *Podocarpus nagi* possibly is defensible as a distinct taxon, having leaves ovate, compared to the usual elongated outline.

Section **Afrocarpus** (Buchholz & Gray) de Laubenfels, comb. nov.

Podocarpus section *Afrocarpus* Buchholz & Gray, Jour. Arnold Arb. 29: 57. 1948. Type species: *Podocarpus falcatus* (Thunb.) R. Br. [*Decussocarpus falcatus* (Thunb.) de Laubenfels].

Decussocarpus falcatus (Thunb.) de Laubenfels, comb. nov.

Taxus falcata Thunb. Prodr. Pl. Capensis, 117. 1800. Type: *Thunberg* in 1773-1774, Cape of Good Hope (not seen).

Podocarpus falcatus (Thunb.) R. Br. ex Mirb. Mém. Mus. Hist. Nat. Paris 13: 75. 1825.

Podocarpus gracillimus Stapf, Fl. Trop. Afr. [ed. Prain] 6(2): 343. 1917. Type: *Nelson 423*, Transvaal, Houtschberg.

Decussocarpus gracilior (Pilger) de Laubenfels, comb. nov.

Podocarpus gracilior Pilger, Pflanzenreich IV. 5 (Heft 18): 71. 1903. Type: *Schimper 1160*, Ethiopia, Chere.

Decussocarpus mannii (Hook.) de Laubenfels, comb. nov.

Podocarpus mannii Hook. Jour. Linn. Soc. 7: 218. 1864. Type: *Mann 1065*, St. Thomas Island.

Nageia mannii (Hook.) Kuntze, Rev. Gen. Pl. 800. 1891.

Podocarpus usambarensis Pilger, Pflanzenreich IV. 5 (Heft 18): 70. 1903. Lectotype: *Holst 2467*, Tanganyika, Usambara.

Podocarpus dawei Stapf, Fl. Trop. Afr. [ed. Prain] 6(2): 342. 1917. Type: *Dawe 961*, Uganda.

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bb20786 (3); *bb21151* (35);
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bb30961, *bb31500*, *bb31506*,
bb31536 (34); *bb31596* (35);
bb32284, *bb32434*, *bb33046* (5a)
- New Guinea Forestry Department
 (NGF), the following by anony-
 mous collectors: NGF-W41 (34);
 NGF 3128 (21c); NGF 4503 (34)
 Nicholson SAN 17292 (5a); SAN
 17823 (1); SAN 17826 (14); SAN
 17827 (13); SAN 39766 (25);
 SAN 39768 (13)
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 Noakes 20133, 22147 (34)
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- Ocampo 27926 (24)
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 Pierre 1396 (2); 5528 (21b); 5529,
 5530 (34); 19074 (2)
 Pitard 2090 (18)
 Poilane 25 (2); 320 (21b); 1539 (2);
 2147, 3387 (21b); 3455, 3782 (2);
 4038 (21b); 4411 (2); 5963 (34);
- Netherlands Indies Forest Service
 (NIFS), the following by anony-
 mous collectors: *Cel/III-80*, *Cel/*
III-143, *Cel/III-146*, *bbE1084*,
bbE1106, *bbE1352*, *bbE1357*, *TB200*
 (34); *12T1P13*, *12T1P185* (35);
bb2768 (21b); *bb3829* (12a); *bb3903*
 (5a); *bb4130*, *bb4866*, *bb5443*
 (21b); *bb5460* (21a); *bb5671*,
bb6737, *bb7077* (12a); *bb7708*,
bb8737 (21b); *bb8842* (34); *bb9003*
 (21a); *bb9664* (17); *bb9671* (1);
bb9696 (34); *bb10748* (12a);
bb11803 (21a); *bb13633* (26);
bb14390, *bb14519* (6a); *bb15026*,
bb15154 (1); *bb15155* (21b);
bb15504 (21a); *bb15602* (34);
bb17229 (35); *bb17269* (21a);

- 6509 (21b); 7095 (2); 9103, 10293, 10995, 11110, 13644 (21b); 14664 (34); 14707 (2); 15922, 16092, 23118 (21b); 23216, 24234, 24314 (34); 29808 (37); 29960 (21b); 31558 (34); 32825, 33351 (2); 35595 (21b); 35675 (34)
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- Posthumus 2175 (5a); 3235 (21a)
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- Pullen 273A (1); 313, 313A (26); 338 (28); 2674, 2680 (6b); 2716, 2716A (23); 2840 (31); 5052 (26); 5111, 5138 (28); 5267 (26); 5914, 5930 (21c); 5930A (3); 5932 (34); 6116 (26)
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- Ramos 19557 (24); 77401 (1)
- Ramos & Edaña 26394 (17); 26501 (12); 37757, 38738 (1); 45005 (24); 46333 (34)
- Ramos & Pascasio 34497 (5a)
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- Robbins 238 (26); 598 (3); 673 (26); 718 (28); 3112 (26); 3214 (27); 3266 (6b)
- Robinson 5656 (24)
- Robinson & Kloss 6053 (12a)
- Rohrdorf 178 (33)
- Rossum 122, 784 (5a)
- Sadau 42890 (21a)
- Salverda bb22564 (1); bb22571, bb22576 (6b)
- Santos 31817 (21c)
- Sarasin 294 (8)
- Sario SAN 32246 (21a)
- Sarip 371 (21a)
- Sarlin 73 (33); 228 (32); 229 (18); 237 (22); 242 (15); 244, 341 (22)
- Saunders 708 (28); 804 (26); 823 (21c); 824 (1); 861 (21c); 1025 (1); 1048 (21c); 1088 (34)
- Sayers NGF 21613 (21c)
- Schiffner 1473, 1474 (21b); 1475 (21a)
- Schlechter 15175, 15176 (8); 15331, 15332 (32)
- Schmid 137 (29)
- Schodde 1561 (21c); 2014 (1); 2021, 2104 (26)
- Schram BW 1785, BW 6021, BW 6174, BW 6705, BW 6760, BW 7951 (34); BW 7972, BW 9271 (6a); BW 10596 (34)
- Seemann 573 (6a); 576 (31)
- Shockton 2699 (1)
- Sijde BW 5579 (34); BW 5596 (6a)
- Sinclair 10578, 38991 (34); 39094 (2)
- Sinclair & Kadim 9053 (1); 9146 (25); 10318 (5a)
- Sinclair & Salleh SFN 40798 (35)
- Sing JC/59 (5a)
- Singh SAN 24336 (5a)
- Skottsberg 202 (32)
- Smit BW 2314 (34)
- Smith, A. C. 1773 (6a); 1796 (31); 4122 (30); 4901 (21b); 5734, 6244 (6a); 6245 (21b); 7076 (31)
- Smith, L. S. NGF 1352 (6a)
- Smith, R. 66 (38)
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- Smythies S10601 (21c); S10607 (12a); S10622 (1)
- Sonohara, Tawada, & Amano 6290 (38)
- Spurway 376 (5b)
- Stauffer 5651 (1); 5652 (21c); 5670 (28); 5729 (18); 5807 (33)
- Stauffer & Blanchon 5812 (8)
- Stauffer, Blanchon & Boulet 5778 (22)
- Stauffer & Kuruvoli 5841 (6a)
- Stefels BW 2006 (21c); BW 2008, BW 2010 (1); BW 2014 (21c);

- BW* 2015 (3); *BW* 2031 (1); *BW* 2033 (3); *BW* 2038 (21c); *BW* 3147 (34)
 Steiner 2032 (24); 2150 (1); 2207 (24)
 Stern 2242 (21c)
 Stern & Rojo 2289, 2292 (21c)
 Steup *bb*23045 (6a)
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 Stresemann 125 (26); 133 (1); 158 (21b); 251, 276A (26); 354, 363 (21b); 395 (3)
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 Surbeck 107 (12a); 532 (21b)
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- Tagei 1795 (5b)
 Tang 438 (21b); 457 (5a)
 Telussa *BW* 5158 (34)
 Teysmann 169 (17); 8617 (5a); 11598 (34); 11599 (5a); 21647 (2)
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 Toropai *NGF* 17153 (1)
 Tothill 553 (6a); 844, 845 (31); 854 (6a)
 Toxopeus 427 (3); 485 (21b)
 Tsang 681, *L.U.* 17430 (38); 20123, 25273 (37); 27332 (21b)
 Tsang & Fung *L.U.* 18100 (52)
 Tuckwell *W*1553 (26)
- Van Römer 736 (26); 1233 (12c)
 Van Royen 3721 (1); 3857 (3); 3873 (1); 3895 (21c); 5058 (34); *NGF* 16182 (1); *NGF* 20289 (23); *NGF* 20309 (26)
 Van Royen & Sleumer 6073 (31); 6246 (6a); 7219 (3); 7403 (1); 7948 (3); 7948A (21c); 7948B (3); 8203A (19)
- Van Royen, Sleumer, & Schram 7791 (12a)
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 Vaughn 3254 (31); 3258 (21b)
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 Versteegh *BW* 248 (1); *BW* 250 (21c); *BW* 253 (1); *BW* 269 (3); *BW* 281 (1); *BW* 913 (31); *BW* 2537 (26); *BW* 3009 (1); *BW* 3041 (6b); *BW* 4754, *BW* 4891, *BW* 4985, *BW* 7378 (6a); *BW* 7596, *BW* 10407 (1); *BW* 10411 (21c); *BW* 12610 (21b); *BW* 15249 (6a)
 Versteegh & Kalkman *BW* 5594 (6a)
 Versteegh & Koster *BW* 14 (21b)
 Vidal 623 (24); 3910 (13)
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 Vink & Schram *BW* 8620 (6b); *BW* 8667 (23); *BW* 8730 (31); *BW* 8731 (21c); *BW* 8746 (3); *BW* 8764 (1); *BW* 8796, *BW* 8914 (6b); *BW* 8945 (1)
 Virot 8 (32); 9 (9); 10 (29); 37 (7); 38 (32); 39 (18); 40 (9); 152 (8); 187 (7); 206 (22); 400 (7); 469 (18); 658 (33)
- Wakau 4155 (2)
 Walker, F. S. *BSIP* 212 (31); *BSIP* 247 (13)
 Walker 70 (2); *ANU* 859, *ANU* 859A (1); 5649 (38); 7526 (21c)
 Wallich 6045 (2); 6050 (34)
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 Warburg 11119 (21a); 14721 (21b)
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 White & Gray *NGF* 10407 (6a); *NGF* 10415 (34)
 Whitford 951 (24); 1353 (34)
 Whitmore 2368 (21b)

- Williams 399, 624, 752, 753, 1035 (34); 1298, 1299 (21c)
- Wilson 6262, 8064, 10242, 10279, 11109 (38)
- Winkler 512 (1); 1035 (21a); 1036 (1); 1037 (13); 1866 (21a)
- Womersley *NGF* 3704 (34); *NGF* 4420 (3); *NGF* 4428 (23); *NGF* 4483 (19); *NGF* 5338 (21c); *NGF* 5351 (1); *NGF* 5353 (21c); *NGF* 5354 (19); *NGF* 8852, *NGF* 8861 (28); *NGF* 9419 (19); *NGF* 9430 (21c); *NGF* 11038 (19); *NGF* 11067, *NGF* 11260 (21c); *NGF* 13922 (19); *NGF* 14018 (26); *NGF* 14253 (21c); *NGF* 17621 (34); *NGF* 17902 (1); *NGF* 17939 (23); *NGF* 19298 (34); *NGF* 24563 (21c); *NGF* 24569 (26); *NGF* 24928 (21b)
- Womersley & deLaubenfels *NGF* 19460 (21c)
- Womersley & Floyd *NGF* 6138 (21c)
- Womersley & Millar *NGF* 7680 (3); *NGF* 8324 (21c)
- Womersley & Sleumer *NGF* 14013 (21c)
- Wood 1244 (34); *SAN* 4172 (5b); *SAN* A4179 (17)
- Wood & Wyatt-Smith *SAN* A4493 (25)
- Wray 1028 (2); 1198 (21b); 3875 (12b); 3899 (2)
- Wray & Robinson 5354, 5380 (2)
- Wyatt-Smith 71650, 80370, 80371 (1); 93115 (17)
- Yapp 493 (12a)
- Yates 1987, 2148 (21b); 2554 (34)
- Zollinger 2262 (21a); 3025 (34)
- Zwart 6517 (21d)

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THE VASCULAR SYSTEM IN THE AXIS OF DRACAENA
FRAGRANS (AGAVACEAE),

1. DISTRIBUTION AND DEVELOPMENT OF PRIMARY STRANDS.

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WE HAVE OUTLINED THE STATE of existing knowledge of the vascular anatomy of monocotyledons with secondary growth in a previous article which serves as an introduction to our present studies (Tomlinson & Zimmermann, 1969). These have been concerned with a number of genera in the Agavaceae. There are quantitative and often diagnostic anatomical differences between the plants we have studied, but we believe that fundamental principles of vascular distribution is the same in all of them. We have therefore restricted our description to one species, *Dracaena fragrans* (L.) Ker-Gawl., of which we had abundant living material available for a detailed study. The same species had also been used by earlier investigators of this problem (e.g., Cordemoy, 1894; Meneghini, 1836; von Mohl, 1824) although often under the older, now incorrect name of *Aletris fragrans* L. Where necessary, however, we shall refer to other plant species. For convenience, our results are presented as two separate articles, devoted to primary and secondary tissues respectively, although such a separation is somewhat arbitrary. Indeed, we will have cause to show that the two types of vascular tissue are interdependent and often continuous.

MATERIALS AND METHODS

Sectioning. Specimens investigated were collected from a large clump cultivated at the Fairchild Tropical Garden. Material was either sectioned freshly or after fixation in FAA and subsequent washing. For the study of the course of vascular bundles sequential series of transverse sections were cut on a "Reichert" sliding microtome from two lengths of distal mature shoots, each representing a sympodium. Selection of material needed some care because in some shoots the central tissue is easily torn during sectioning. For the investigation of the vascular anatomy of leaf-trace departure a complete series of sections 40μ thick was prepared. For the analysis of longitudinal continuity of vascular traces sections 33μ thick at intervals of 100μ were used. These sections were stained in safranin and Delafield's haematoxylin and mounted permanently in "Piccolyte."

For the study of vascular development in the crown, serial transverse and longitudinal sections 10μ thick of shoot apices were cut on a rotary

¹ Contribution to a study of the vascular system of monocotyledons by one of us (P.B.T.), supported by N. S. F. grant GB-5762-X.

microtome from material embedded in "Paraplast." Routine methods of embedding, staining and mounting were employed. Because of the wide diameter of these developing crowns, pieces of ribbon containing only four sections were mounted on each slide.

Serial analysis. Cinematographic analysis of the three-dimensional vascular structure was carried out with the series of sections from the mature stem. These methods have been described in ample detail in previous papers (Zimmermann & Tomlinson, 1965, 1966). The method of plotting provascular strands in the series of sections from the meristematic crown has also been described in previous papers (Zimmermann & Tomlinson, 1967, 1968). The optical shuttle was employed for plotting, according to the procedure described in the paper on the vascular development of *Prionium* (Zimmermann & Tomlinson, 1968). A slight methodical variation was necessary because each slide in this series contained four sections. Most strands can easily be followed by matching the corresponding section on two successive slides with an interval of 3 sections between. In areas where provascular strands make sharp turns (immediately below the apical meristem) and require the use of each section, optical alignment was achieved in the following way: *5d-6a*, *5d-6b*, *5d-6c*, *6c-7a*, *6d-7a*, etc., whereby the number indicates the slide, the letter the section on the slide, and the italics mark the sequence of photography. The reader can easily appreciate that alignment had to be achieved over an interval of two sections (e.g., *5d-6c* above) once every four sections. With the *Dracaena* crown this was just possible without losing continuity of the strand which was plotted. There is no question that the procedure is easier to follow when each slide contains only a single section.

GENERAL MORPHOLOGY AND ANATOMY

Growth habit. *Dracaena fragrans*, a native of tropical Africa, is a common ornamental in South Florida. It has apparently been known in cultivation in Europe at least since 1768 (Sims, 1808). In cultivation it forms a diffuse shrub or rarely a low tree. Basal shoots are straight and erect, but distal branches are often bent over by the weight of the terminal cluster of leaves. Leaves are lanceolate, up to 75 cm. long, and lack a petiole. Their insertion is open but broad and even overlapping. On vigorous shoots, leaves persist for a long time, so that leafy shoots up to 2 m. high may be present. Otherwise on suppressed and less vigorous shoots leaves form the distinct terminal cluster which is so common in many other woody monocotyledons. The longevity of leaves is of considerable anatomical significance, a point which will be discussed later. Each leaf subtends a minute axillary bud enclosed by its prophyll.

Inflorescences are always terminal (FIG. 1) and branching is closely associated with flowering. Flowering and resultant branching begins in plants 2 to 3 years old when they are about 1 m. high. The transition from vegetative to reproductive state of the axis is marked by a gradual reduc-